HOW YOUR CAR'S ELECTRONIC TRANSMISSION WORKS!

DO YOUR REMOTES HAVE 'HIDDEN' BUTTONS?

Australia's Top Selling Electronics Magazine

Electronics Australia

WITH ETI

AUSTRALIAN PUBLICATION

NDD

APRIL 1993

Aust* $4.95
NZ $6.95 incl GST

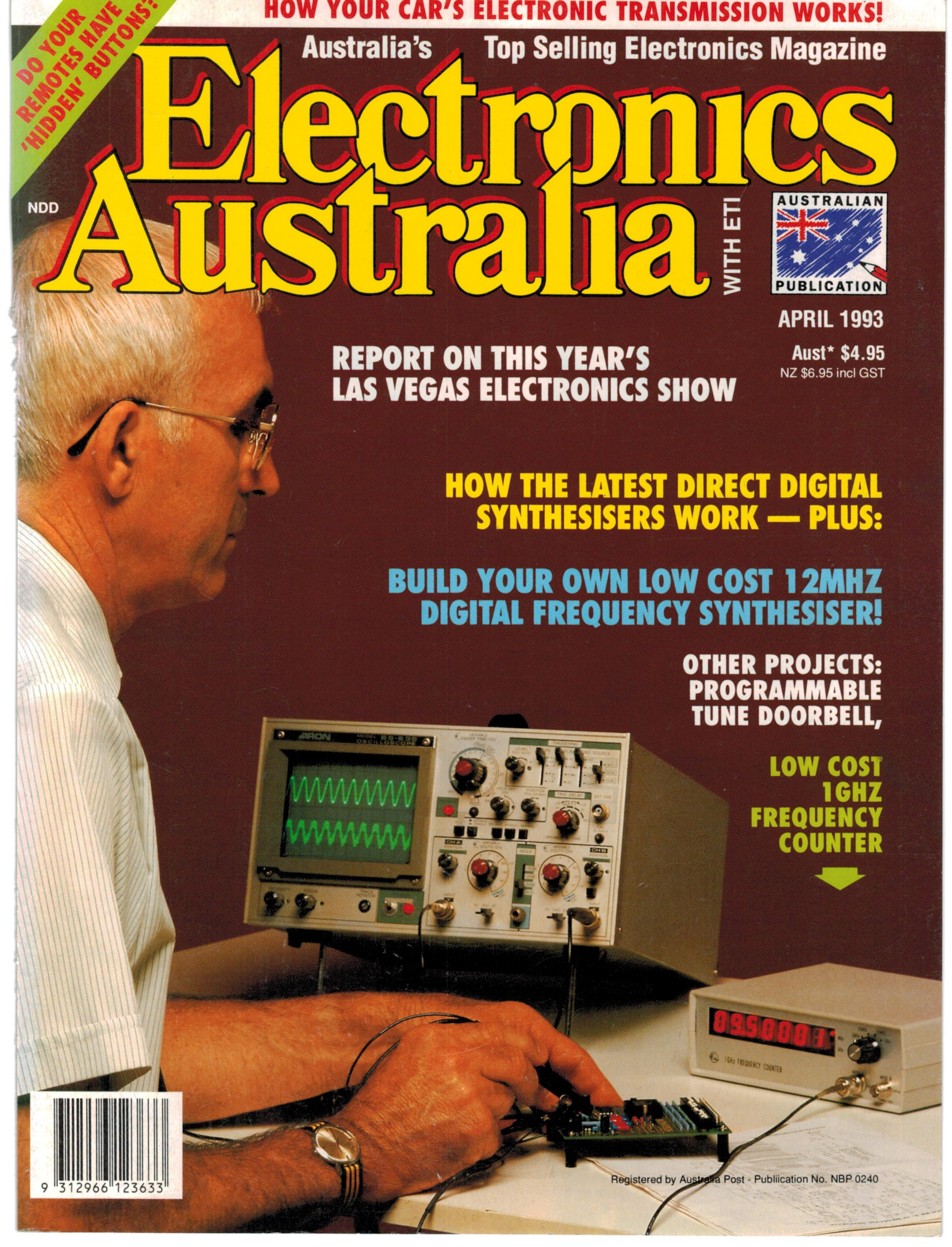
REPORT ON THIS YEAR'S LAS VEGAS ELECTRONICS SHOW

HOW THE LATEST DIRECT DIGITAL SYNTHESISERS WORK — PLUS:

BUILD YOUR OWN LOW COST 12MHZ DIGITAL FREQUENCY SYNTHESISER!

OTHER PROJECTS: PROGRAMMABLE TUNE DOORBELL,

LOW COST 1GHZ FREQUENCY COUNTER



9 312966 123633

Registered by Australia Post - Publiication No. NBP 0240

You don't just buy a great computer...
...You buy the company that stands behind it!

UPGRADE SPECIAL

386 SX 33 MHz System Board	$245
386 DX 40 MHz System Board	$388
486 DLC 33 MHz System Board	$668
486 DX 33 MHz System Board	$1,188
486 DX 50 MHz System Board	$1,499
70 nsec. 1M SIMM RAM (per MB)	$60
70 nsec. 4M SIMM RAM (per MB)	$205
Floppy Disk Drive (1.2 or 1.4)	$100
170 MB Hard Disk	$576
210 MB Hard Disk Drive	$738
Sony CD ROM Kit	$639
Sound Blaster & CD ROM Pack	$750
IBM NLQ Printer	$239
HP 500C Deskjet Colour Printer	$1,180
HP 2P Laser Printer	$1,399
Trident 1MB Super VGA Card	$110
Tseng T4000 32 K Colour VGA Card	$180
Paradise Windows Fast Card	$245
NEC 3FG Monitor & SVGA Card	$990
MS Works for Windows	$119
MS Windows 3.1	$99
WordPerfect 5.1 DOS/Windows	$250

NOTEBOOK 386 SX 25

$2,380

- 386 SX 25 MHz System Board
- 4 MB RAM
- 1.4 MB Floppy Disk Drive
- 80 MB Hard Disk Drive

NOTEBOOK 486 SX 25

$3,190

- 486 SX 25 MHz System Board
- 4 MB RAM
- 1.4 MB Floppy Disk Drive
- 120 MB Hard Disk Drive

BUDGET PAK 386 SX 33

$1,900

- 386 SX 33 MHz System Board
- 2 MB RAM expandable to 1 6 MB
- 1.2 or 1.4 MB Floppy Disk Drive
- 85 MB IDE Hard Disk Drive
- 14" SVGA Colour Monitor & Card
- MS Windows & Works
- IBM NLQ Printer

VALUE PAK 486 DLC 33

$2,600

- 486 Cyrix 33 MHz System Board
- 4 MB RAM expandable to 32MB
- 1.2 and 1.4 MB Floppy Disk Drive
- 128 MB IDE Hard Disk Drive
- 14" SVGA Colour Monitor & Card
- MS Windows & Works
- IBM NLQ Printer

SUPER PAK 386 DX 40

$2,000

- 386 DX 40 MHz System Board
- 4 MB RAM expandable to 32 MB
- 1.2 and 1.4 MB Floppy Disk Drive
- 128 MB IDE Hard Disk Drive
- Trident 1 MB SVGA Card
- Samsung 14" SVGA Colour Monitor

SMART PAK 486 DX/2 50

$3,399

- 486 DX/2 50 MHz System Board
- 4 MB RAM expandable to 32 MB
- 1.2 and 1.4 MB Floppy Disk Drive
- 210 MB IDE Hard Disk Drive
- Trident 1 MB SVGA Card
- Samsung 14" SVGA Colour Monitor

PRO PAK 486 DX 33

$3,575

- Intel 486 DX 33 MHz System Board
- 4 MB RAM expandable to 32 MB
- 1.2 and 1.4 MB Floppy Disk Drive
- 170 MB IDE Hard Disk Drive
- Tseng 1MB SVGA Card
- NEC Multisync 3FG Colour Monitor

POWER PAK 486 DX 50

$4,680

- Intel DX 50 MHz System Board
- 8 MB RAM expandable to 32 MB
- 1.2 and 1.4 MB Floppy Disk Drive
- 210 MB IDE Hard Disk Drive
- Tseng 1 MB 32K Colour SVGA Card
- NEC Multisync 4FG Colour Monitor

* All prices includes sales tax.

We stand behind you...
We stand behind our computers.

HEAD OFFICE:

AVO Electronic Systems Pty Ltd
188 - 192 Pacific Highway
(Cnr Bellvue Ave)
ST LEONARDS NSW 2065
TEL: (02) 906 2655
FAX: (02) 906 2735

READER INFO NO. 1

BRANCHES:

AVO Computers (North Sydney)
99 Mount Street
(Cnr Walker St)
Shop 8, Mount Street Plaza
NORTH SYDNEY NSW 2060
TEL: (02) 959 3328
FAX: (02) 959 3373

AVO Computers (Chatswood)
22 Thomas Street
CHATSWOOD NSW 2067
TEL: (02) 415 2626
FAX: (02) 415 2640

AVO COMPUTERS
Just Great!

Electronics Australia WITH eti

Volume 55, No.4

April 1993

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Virtually, a personal video

One of the new products that Louis Challis spotted at the Las Vegas show was the Virtual Vision 'Sport' personal TV. This has a pair of special glasses, which cause the wearer to see a large 'virtual image' some metres ahead of them. Louis' report on the show begins on page 8...

Snowbound station...

Our shortwave columnist Arthur Cushen reports that Alaska is now on the shortwave broadcasting map, thanks to station KNLS. Based in Anchor Point and snowbound for most of the year, the station has special problems — as Arthur explains in his column on page 92.

On the cover

Would you believe that's our Editor's father, checking out the exciting Novatech DDS kit reviewed in this issue (page 16)? No, we didn't think so... It's Jim himself, of course, and he's also using the new low cost 1GHz counter described on page 56. (Picture by Kevin Ling.)

Video and Audio

Features

Projects and Technical

Professional Electronics

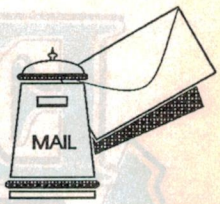
Columns and Comments

Departments

MANAGING EDITOR
Jamieson Rowe, B.A., B.Sc., SMIREE, VK2ZLO
FEATURES EDITOR
Peter Murtagh, B.Sc, Dip.Ed.
TECHNICAL EDITOR
Rob Evans, CET (RMIT)
TECHNICAL CONSULTANT
Peter Phillips, B.Ed., Dip Ed., ECC
CONTRIBUTORS
Neville Williams, FIREE, VK2XV
Jim Lawler, MTETIA
Arthur Cushen, MBE
Tom Moffat, VK7TM
Peter Lankshear
Louis Challis
Major Al Younger (USAR, Ret.)
SECRETARY
Ana Maria Zamora
DRAFTING
Karen Rowlands
COVER DESIGNER
Clive Davis
PRODUCTION
Patrice Wohlnick, Mal Burgess
ADVERTISING PRODUCTION
Anthony Macarounas
CIRCULATION MANAGER
Michael Prior
PUBLISHER
Michael Hannan
ADVERTISING MANAGER
Selwyn Sayers (02) 353 0734
HEAD OFFICE - EDITORIAL
180 Bourke Road, Alexandria, NSW 2015
P.O. Box 199, Alexandria 2015
Fax number: (02) 353 0613
Reader Services: Phone (02) 353 0620
Subscriptions enquiries: phone (02) 353 9944
Book Shop enquiries: phone (02) 353 9944
INTERSTATE ADVERTISING OFFICES
MELBOURNE: 504 Princes Highway, Noble Park, Vic 3174. Phone (03) 795 3666.
Fax: (03) 701 1534, Nikki Roche.
BRISBANE: 26 Chermside Street, Newstead, Qld 4006. Phone: (07) 854 1119.
Fax: (07) 252 3692, Ken Yates.
ADELAIDE: 98 Jervois Street, Torrensville, SA 5031. Phone: (08) 352 8666,
Fax: (08) 352 6033, Sue Bowshall.
PERTH: Allen & Associates, 54 Havelock Street, West Perth, WA 6005. Phone: (09) 321 2998,
Fax (09) 321 2940, Tony Allen.
UNITED KINGDOM: John Fairfax & Sons (Aust), 12 Norwich Street, London, EC4A 1BH.
Phone: (71) 353 9321, Fax: (71) 583 0348
ASIA: Headway Media Services Ltd, Room 2101, Causeway Bay Centre, 15-23 Sugar Street, Hong Kong. Phone: 516 8002,
Fax: (862) 890 4811, Adrian Batten.
ELECTRONICS AUSTRALIA is published by Federal Publishing Company a division of Eastern Suburbs Newspapers Partnership, which is owned by General Newspapers Pty Ltd.
A.C.N. 000 117 322
Double Bay Newspapers Pty Ltd.
A.C.N. 000 237 598
and Brehmer Fairfax Pty Ltd.
A.C.N. 008 629 767
180 Bourke Road, Alexandria, NSW 2015.

Printed by Macquarie Print, 51-59 Wheelers Lane, Dubbo NSW, 2830, phone (068) 843 444, for Federal Publishing Company.
Distributed by Newsagents Direct Distribution Pty Ltd, 150 Bourke Road, Alexandria, NSW 2015. (02) 353 9911.
The Australian Publication emblem on the front cover of this magazine is there to signify proudly that the editorial content in this publication is largely produced and edited in Australia, and that most of the advertisements herein are the products and services available within Australia.
ISSN 1036-0212
*Recommended and maximum Australian retail price.

LETTERS TO THE EDITOR



Wesat kit — Tom replies

As the designer of the Listening Post Wesat kit, I feel I must respond to some of the comments made by Peter Williamson in the February issue. Referring to the quality of the pictures produced by the West decoder, he says, "If you are still in doubt, have a close look at Tom Moffat's two pictures, although they appear on the surface to be OK, they do in fact contain quite a lot of noise..."

Well, I dragged out the originals of those two pictures as disk files and carefully studied them again, displayed on the VGA monitor of my IBM-PC. If they contain 'quite a lot of noise', I wasn't able to find it. The pictures contain occasional 'scratches' caused by things like short sharp fades, as the satellite passes over and neighbour's fridges going on and off. I looked closely at white and grey clouds over the Southern Ocean and found them to be clear, solid and noise-free.

It is true that photos of that type reproduced in a magazine are never as good as the originals, but that certainly can't be construed as 'noise'. Disk versions of those two pictures are distributed with the Wesat software, so existing Wesat owners can look for themselves. Listening Post Wesat pictures are also available on bulletin boards in the Wesat Sampler package.

The Wesat decoder was designed especially to work with existing 'wideband' FM receivers, instead of requiring an expensive receiver intended exclusively for weather satellite use and nothing else. Several hundred satisfied enthusiasts are now using their Wesat decoders with existing wideband radios, in conjunction with the cheap but excellent preamplifier kits sold by the WIA in South Australia.

Mr Williamson of course would prefer that intending weather satellite users purchase the SATFAX system, including the special receiver. As an argument against the Listening Post Wesat system he states that "The 150kHz bandwidth of these (wideband) receivers results in noisy images at the best."

Now I really do dispute that statement. Forget about price differences; all I ask is that existing or intending purchasers of SATFAX or Wesat look at the pictures from both systems, prior to making a decision. Quite a few users, including some large educational institutions, tell me they have replaced existing SATFAX systems with Listening Post Wesat, because of its simplicity and because "the pictures are better". Don't believe me? Look for yourself. I rest my case.

Tom Moffat,
High-Tech Tasmania,
Fern Tree, Tas.

Museum needs help

The Sydney Maritime Museum is at present restoring some fine old vessels and proposes to include as far as possible, original electrical and electronic equipment.

We are interested in donations of antique electrical equipment such as switches, light fittings, etc., as well as meters, knife switches, ceramic fuse holders etc., to rebuild the old switchboards. Also, some vessels would have been fitted with early forms of radio communications equipment, so we would be interested in obtaining Naval and Merchant Marine electronic equipment and spare parts. Any items not used on the vessels may eventually form part of a static exhibit. Naturally each donor will be acknowledged.

You have commented in the magazine that equipment of this type may be dumped due to lack of interest. We were recently informed of an old store full of 1920's electrical equipment which was taken to the tip, just weeks before. There must still be much equipment in private hands or perhaps stacked in the back room of an old factory.

If any readers know of equipment that may be suitable for the museum, could they place contact John Rich on 569 4965?

Desmond Kennard,
Sydney Maritime Museum,
PO Box 140,
Pyrmont, NSW 2009

Moffat mistaken

I have been deeply suspicious of GST and when I read the information supplied in 'Moffat's Madhouse' in the August edition my worst fears were realised as I am a small business man in the service industry.

When the December edition came out I read the letter from the Shadow Minister for Science and Technology and I wrote away for the information offered in rela-

tion to GST and small business. Having now digested what I have been sent, I can now see that Mr Moffat was wrong on a number of matters relating to the volume of paperwork that GST will generate — which was my biggest worry. In fact he is so wrong that either he or *EA* should write a retraction or else invite the Minister to print a letter in his column outlining where Mr Moffat was wrong for two reasons:

Firstly because your publication entered the political arena by allowing an article to be published on a political 'hot potato' without firstly checking that the information was correct and secondly because Mr Moffat's article has had the effect of incorrectly frightening small business men and thus influencing voting patterns.

Don Wilkinson,
Slacks Creek, Qld.

Comment: We've published Mr McGauran's letter, Don, and also your own. But that is the end of this still very controversial topic, at least as far as EA is concerned.

Space cover-up?

In her article (November 1992) about NASA's new Mars-mission, Kate Doolan wrote that a Soviet Mars-bent space probe was 'mysteriously' silenced by a 'breakdown'. Yet that wasn't quite the way the Soviets put it at the time.

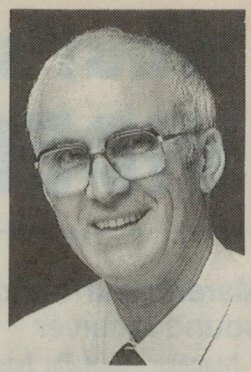
In May, 1989, ATN 7's 11am telecast showed us an inexplicable, miles-long shadow, unrelated to any geographical feature on the planet's surface, as photographed in IR light by the above craft — which later recorded the rapid approach of an object, before going off the air. Only ATN carried the story (and then only once) while the other networks chased ambulances. 'Great Galactical Ghoul'? Why have both the shadow and the craft's destruction been so studiously ignored, even by your author? Let he who thinks the dead silence explains such events tell us why none of the last video frames received have ever been released.

Here's another enigma: The location of the 'neutral point' between here and the moon where our gravities are neutralised may be computed using simple algebra and physics, and up to the early 1960's, both NASA and the Encyclopaedia Britannica also put it at circa 24,000 miles from the moon's centre.

Perhaps Kate can get NASA to explain why it and the Britannica have now almost doubled that value; which in turn demands a lunar surface gravity of about 19.94ft/sec^2, not the 5.36ft/sec^2 they still specify. Please accept that the implications of this near four-fold increase in said value are in no way trivial!

George Lindley,
Redfern, NSW. ❖

EDITORIAL VIEWPOINT



What's the REAL reason for blocking microwave MDS?

As I write this, it's a couple of weeks since the Keating Government's surprise 11th-hour decision to reverse its professed policy of 'technology neutrality' with respect to Pay-TV delivery, and disallow the proposed use of microwave MDS. The initial shock has faded a little, but we're still left with a great deal of confusion regarding the *real* reasons for the decision.

Various theories have been put forward — probably the one that was offered most rapidly, and most forcefully, being that pressure had been applied by either the major owners of existing 'free to air' TV (i.e., paid for by advertising or taxes), or by those planning to become major players in satellite or fibre-optic delivered Pay TV. These two groups have shared members, of course. There's no doubt that both groups would have a vested interest not only in nobbling microwave MDS in particular, but also in either stopping or at least delaying the use of any competing delivery systems like it. Mind you, no evidence seems to have emerged to show that either group *did in fact* apply pressure to the Government to trigger the reversal...

Another theory I heard was that Optus Communications could have applied pressure, on the basis that by allowing microwave MDS to start, the Government was breaching at least the spirit of undertakings given when it purchased Aussat. Part of the deal was that the satellites were to be a major component in Pay TV delivery, and this position might have been undermined by allowing competing delivery systems like microwave MDS to get a 'head start' on direct satellite delivery. As it happens, though, Optus satellite transponders would apparently have been used to provide the main links to localised microwave MDS distribution sites, so this theory seems unlikely.

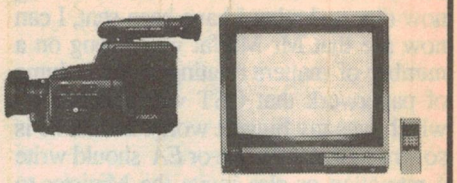
Unfortunately the least plausible explanation seemed to come from the Minister for Communications himself, Senator Collins. In justifying the decision, he claimed that microwave MDS was 'defective and inferior technology'. Exactly how this could be justified escapes me, because as a carrier technology microwave MDS is surely almost identical to the UHF system currently being used to distribute much of our 'free to air' TV programmes — and also to the basic Ku-band satellite system being used to deliver HACBSS TV to remote areas in Australia, as well as Pay TV in many other countries. In fact it's already being used for Pay TV delivery in various countries, very successfully.

What about the advantages of the 'coming soon' compressed digital systems, which offer the ability to deliver much *better* picture and sound quality, plus more channels? It's true that microwave MDS doesn't offer this technology yet, and because of multipath problems it isn't as well suited to digital transmission as satellite delivery. But why do we have to have a single system — why can't we have a number of them, including analog pay TV on MDS, and digital pay TV on satellite?

It's all very mysterious, don't you think? One might be excused for seeing it all as simply yet another move to ensure that Australians have to wait as long as possible before they get any additional freedom of choice when it comes to TV viewing.

Jim Rowe

What's New in VIDEO and AUDIO



Marantz surround sound receiver

Marantz Australia has announced the SR-92 Dolby Pro-Logic Surround Sound Receiver, which incorporates the functions of a tuner, surround sound processor and multi-channel amplifier into a single unit. As such it is very suitable as the heart of an audio/visual system, combining flexibility, ease of use and state of the art audio circuitry.

The SR-92 features a newly developed high performance Dolby Pro-Logic decoder chip, which separates the two stereo channels of movie soundtracks into left, right, centre and surround channels with high separation accuracy and 'pinpoint placement' of music, dialog and surround sound effects. The remote control and built-in Dolby test-tone generator facilitate set-up and balancing.

Unlike many systems, which only provide a 'phantom' centre channel, the SR-92 incorporates five separate amplifier channels to power the main left and right speakers, a centre channel speaker, and a pair of surround speakers.

Power output is 110 watts per channel main left and right, 75W for the centre channel and 35W for the surround channels. In addition to the Dolby Surround programs, the receiver also features hall, matrix and simulated stereo surround modes, with variable digital delay via the remote control.

An important feature of the SR-92 is its multi-room capability, allowing the main system to reproduce one audio source, while a secondary location reproduces another.

For example, the system can reproduce a movie soundtrack in full surround sound in the lounge room while simultaneously playing a CD in the den. This function is controlled either via the front panel or through an optional multi room remote, the IR-92.

The receiver has a full range of input and output terminals, including audio disc and tape players, and video sources such as two hi-fi VCRs and a laserdisc player. S-video connectors allow a video signal to be separated into two channels to provide maximum colour sharpness, while five separate pre-out/main in connectors allow external power amplifiers or dedicated signal processors to be hooked up to the system.

DCC deck from Technics

Panasonic Australia has launched its first compact cassette (DCC) deck, the Technics RS-DC10.

Panasonic is a joint developer in the new technology, and is entering the market with a fully featured model. The RS-DC10 player is designed to capitalise on the format's compatibility with conventional analog audio cassettes, with its ability to play both formats on the one deck.

Among the many other attractive features of the Technics DCC deck is its text information display, showing the artist, album title and song being played.

Early purchasers of the Technics DCC deck will receive a special gift with purchase of 10 pre-recorded DCC tapes, which will include Eurythmics' *Greatest Hits*, Bobby Brown *Bobby*, Glen Miller in the *Digital Mood*, *Caballe, Domingo and Carreras*.

Panasonic will also be releasing two blank DCC tapes. A 60 minute and 90 minute will be released with recommended retail prices of $19.99 and $21.99 respectively.

Music lovers are being assured that they will have no trouble collecting an extensive variety of prerecorded DCC tapes, with six major music distributors geared to release more than 800 titles by the end of the year.

Teac's CD player is 'world's best'

Teac Australia have recently added a 'flagship' integrated CD player to the line up: the Esoteric *X-1*. Describing it, Frank Garonzi, Teac's Product Director Marketing said, "I believe Teac has produced what will soon be accepted as the finest integrated CD player available." This 18kg 'tour de force of engineering' is finished in a high density fascia crafted from ceramic and stainless steel, and follows similar lines to Teac's CD separates with a solid quality finish and a centre mounted tray.

Teac engineers have gone to considerable lengths to eliminate vibration and wobbling which could effect tracking accuracy. As a result, like the P-2 and D-2 separate units, the X-1 employs Teac's proprietary VRDS (vibration free rigid disc clamping system), which is claimed to reduce disc vibration to an unprecedented low level.

Unlike other disc clamping systems, VRDS employs a full sized overhead turntable made of die-cast zinc alloy to stabilise the full disc. The turntable surface is slightly concave, so the disc presses snugly against it when clamped in place from below. Also the clamper is claimed to keep the CD precisely centred, lessening the demands made on the tracking servos. Teac claim this is the first integrated player to feature such an advanced transport system.

The X-1 employs four 20-bit D/A converters (AD182) which are addressed by high quality NPC eight times over-sampling filters. The internal architecture is said to enable the fourth significant bit, to ensure that all signals below -18dB are shifted away from the nominal zero crosspoint. This is said to reduce the effects of digital zero-cross distortion by approximately 1/8th, leaving the musical signal in the critical -18dB range free from non-linearity and distortion.

The 20-bit DAC's are also separated into differential pairs, for both left and right channels. Teac claim this reduces noise, distortion and improves linearity. This claim is supported by an impressive S/N ratio of 112dB. Similarly, resolution is equally impressive with the ability to resolve down to 0.4dB at -100dB (ref 1kHz and 20kHz).

A main reason for such impressive figures is attributed to Teac's proprietary 'ZD-11' circuitry, which employs a technique known as 'dithering'. This uses high level ultrasonic noise to randomise the fixed and predictable quantisation errors that accompany low level digital signals. All critical internal wiring including transmission from the digital to the audio stages is electronically balanced, to guard against extraneous signal pick up. The X-1 also features professional +4dB XLR balanced outputs in addition to the standard unbalanced types.

The X-1 is covered by a five year parts and labour warranty, has a recommended retail price of $5499 and is available at selected Teac dealers only. For further information contact Teac on (03) 646 1733.

Stylish 'European' amps from Kenwood

As a follow-on to their KA-3020 integrated amplifiers, Kenwood have now introduced two new models: the KA-3050R (50 watts RMS/channel) and the KA-2050R (35 watts RMS/channel) integrated amplifiers. From their quality internal components to the airbrushed anodised finish on the curved facia panels these models have the distinct hallmark of quality European styles.

Kenwood have used 'discrete component topology' in the development of the amplifiers' power supply, power amplifier and low noise phono sections (KA-3050R). The firm's proprietary 'Pure Signal Ground Line' technology has also been employed, to eliminate interference from ground potentials of other circuits and equipment. This is claimed to eliminate possible 'earth loop' problems.

Another added feature of both models is the comprehensive remote control facility, the first for an integrated amp of this quality at this price point. The 28-key IR remote addresses all features including power ON/OFF, loudness ON/OFF, volume UP/DOWN, input selection CD/Phono/Tuner/Auxiliary/Tape I and Tape II/DAT monitor. Input facilities include phono MN (MC KA-3050R special low noise FETS), CD, tuner, auxiliary, tape I and tape II.

When used with other compatible Kenwood components, the remote controller will address the basic functions of a tuner, CD player and double cassette deck. Heavy duty multi-way binding posts have been provided, for two sets of speakers that can be either switched from system A to system B or both systems can run simultaneously.

Technical specifications for the KA-3050R are: output power 55/55W cont. into 8ohms (IEC); frequency response 5Hz to 90kHz -3dB; S/N 101dB (CD, Aux) 82dB (phono MM) 75dB (phono MC); THD 0.05% (45W into 8ohms, 20Hz to 20kHz); and IMD 0.05% (45 watts into 8ohms).

Similarly those for the KA-2050R are: output power 30/30W cont. 8ohms (IEC); frequency response 5Hz to 90kHz -3dB; S/N 101dB (CD, Aux) 80dB (phono MM); THD 0.05% (30W into 8ohms, 20Hz to 20kHz); and IMD 0.05% (30 watts into 8ohms). Both models are covered by a 12 month parts and labour warranty and have recommended retail prices of $599 (KA-3050R) and $499 (KA-2050R).

S-VHS cassette range from Sony

Sony has released a new 'master quality' series of S-VHS videocassettes, claimed to provide outstanding video and sound quality because of Sony's enhanced 'hi-packing' technology. This packs more magnetic particles onto the tape using Sony's 'V' orientation, 'triple dispersion' and 'super calendering' technologies to achieve an outstanding 190mT (1900 gauss).

Ultra refined Vivax magnetic particles are said to boost recording of higher frequencies to maximise the full potential of the S-VHS format. A 'super RF binder' is said to optimise video head contact, reducing spacing loss and rubbing noise for 'clear, sharp' picture contrast.

MQSE video cassettes go one step further, with an 'anti-static' lid which prevents the attraction of dropout - causing dirt and dust particles and is claimed to maintain superior tape performance even after repeated use. The MQSE range is available in 30, 60 and 120 minute durations. ❖

Video & Audio: The Challis Report

Having just recovered from his annual pilgrimage to USA and the Las Vegas CES, Louis Challis has gathered his thoughts, turned to the keyboard and recorded *his* impressions of this year's 'largest toy show on Earth'. Here's what he found to be the memorable of the new products on display...

To most gamblers, a trip to Las Vegas must have feelings not unlike 'A trip to Heaven'. My feelings however are somewhat different, to the extent that each time I depart from Las Vegas' McCarron Airport, with its incongruous lines of poker machines in the departure lounges, I have a queasy feeling that "If I dare to look back, there is a strong possibility that I too will turn into a pillar of salt!"

One of Las Vegas' few grace-saving features is its staging of the Winter Consumer Electronics Show (CES). However things are no longer as good as they were even one year ago, and this year only 80,000 other hardy souls chose to make their annual pilgrimage to Las Vegas for the CES. I too made my pilgrimage, to view what Len Feldman (of *Audio* magazine) has aptly described to me as being "the biggest toy show on Earth" — and never have truer words been spoken in jest.

This year's CES tended to be 'a little more of the same', with only a few outstanding new technological developments. However there were a number of new items of equipment which I consider upstaged *both* Sony's new Mini Disc and Philips/Matsushita's Digital Compact Cassette (DCC) for line honours, in the race for the most innovative and newsworthy items on show.

The first of the exciting new developmnts to catch my eye (literally) was the 'Virtual Visions' Sports Portable Projection TV. This new product embodies a number of unusual concepts, in that its colour TV image is projected on to a special pair of what I would best describe as 'wrap around' eye shades, with a supplementary reflective lens that looks for all the world like a fancy pair of sun glasses.

Whilst the projected image has to be correctly adjusted to match the requirements of your dominant eye (which of course means that you need to know which of your eyes is the dominant one), once this is done the image from the reflective lens appears to be projected some three or four metres in front of you. Your brain is then fooled into thinking that you are looking at a big screen TV — but only with the one eye that the system uses.

Whilst I found that the picture was not as sharp as it might have been (primarily because of the limitations imposed by NTSC's 525-line picture), it was still of reasonable quality and will be further improved by future development in the miniature LCD picture projection display module.

Attracting much attention at the CES was the 'Virtual Visions' Sports portable projection TV, which causes the wearer to see a large image some four metres in front.

The 'Virtual Vision' Sports system has two major components, which are the fancy eye-shade unit and the belt mounted electronic pack — which is nearly twice the size of a small personal tape player unit, and one quarter of whose bulk is taken up by the battery pack. As well as containing a conventional TV tuner and the aerial, the unit is also designed to accept a special supplementary UHF receiver unit.

The operating frequency of the supplementary tuner is set in the 900MHz band and allows the unit to receive signals from a dedicated TV transmitter, through which commercial or residential monitoring signals can be radiated.

Whilst the predominant and major market for such a product has been aimed at consumers, there are nonetheless a wide range of professional and semi-professional applications which the company's marketing advisers have already pin-pointed.

These include the systems used by security personnel, who would thus be able to monitor their normal viewing area whilst simultaneously observing a remote and separate scene by means of the system.

An equally practical application which they identified would allow a mother to watch TV, or undertake household chores, whilst simultaneously being able to view children playing or asleep. Magnavox USA were marketing and displaying a low cost NTSC observation system for under US$300 which would dovetail in well with such a system, and Philips have a similar PAL-based system in Europe, which would be perfect for similar Australian applications.

Whilst this system clearly falls short of the 'virtual reality' goal which so many US firms are currently chasing, that goal is closer than you think. Other research work which I viewed in Southern California, when ultimately combined with either the Virtual Vision's Sports System or a similar system, will undoubtedly bring that concept one step closer to fruition.

Dan Branley, one of Virtual Vision's marketing consultants, with whom I discussed the product's technical features, assured me that they are already working on a PAL version so that they can cater for anticipated world wide demand.

Virtual Vision's Sports System is expected to go on sale in the US around

THIS YEAR'S WINTER

Also displayed was Kodak's PCD-870 Photo CD player, which allows the user to play back high resolution colour images on their TV receiver — or feed the images into their personal computer, for desktop publishing and other uses.

April this year at approximately US$900, and the buyers are lining up to place their orders...

New speakers

An equally innovative product to emerge at the CES, and whose presence I nearly missed, is the new AuraSound speaker technology. The AuraSound system employs a magnet with radially oriented flux, in lieu of the conventional axial magnet which has now been in use for more than 60 years.

AuraSound claim that their high-energy magnet system, when incorporated in a loudspeaker drive motor assembly, results in outstanding new high efficiency loudspeakers which cover the full gambit of consumer and professional applications.

The use of the system leads to a number of simultaneous advantages over those which they claim their system will ultimately replace. The more significant advantages are prospective reductions in weight, dramatic reduction in stray magnetic flux (which of course has a significant advantage for speakers used in TV sets and computers), and a lower cost of manufacture — which attracts everybody's eye.

When the AuraSound system is integrated into professional and high powered speakers, it offers the potential for providing longer and more effective magnetic paths, through which longer throw voice coils may be more readily and practically achieved. This in turn offers the opportunity to achieve lower distortion, better linearity, and woofer drivers that can operate at lower frequencies than were previously thought practical.

The prototype speakers that I saw (and heard) were impressive. One of AuraSound's first American licensees, Parasound Speakers, were displaying a 450mm (18") diameter subwoofer. This speaker has an 800-watt rating, and a claimed lower cut-off frequency response of 16Hz with an outstanding 75mm linear excursion!

My first question, which must echo yours, was "How can you possibly achieve a radial magnetic field, using

CES '93 IN LAS VEGAS

conventional magnetic materials which don't readily lend themselves to such a concept?" As I soon discovered, and as you will see from the photo (which was inadvertently affected by light), AuraSound have slightly bent the rules, and have cleverly used a circular array of discrete magnets which are bonded into a magnetic matrix. The outer surface of this matrix is very precisely aligned, and in that alignment lies much of their success.

Whilst undoubtedly innovative and unusual, the system nonetheless works exceedingly well — so well in fact, that AuraSound have already signed up orders from Korea for 240,000 of their speakers, which are to be supplied to the Daewoo Electronics company for use in all of its 1993 television set production.

If the AuraSound technology proves to be half as successful in solving the nasty stray leakage flux problems in TV sets, computers and the like, then the days of the conventional loudspeaker drive motor system are clearly numbered, and the AuraSound system may well become the 'norm' rather than the 'exception'.

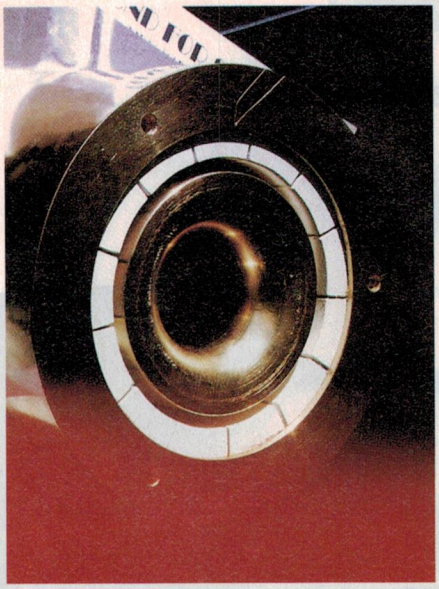
Digital acoustics

The third most exciting development which I observed (but regrettably did not actually hear, at the CES), was the Snell Acoustics 'Room Acoustics and Loudspeaker Correction' system.

I attended a demonstration at the Mirage Hotel at which Kevin Voecks, Chief Engineer of Snell Acoustics, presented an unsuccessful demonstration, and a more successful lecture on his research and development work directed to the improvement of the acoustical characteristics of loudspeakers.

What Snell has set out to achieve is to apply a new science, which he described as 'cyberacoustics', and which involves the automated control of room acoustics by means of digital technology.

The aim of Snell's Cyberacoustic system is to modify each pair of loudspeakers' interaction with the room acoustics, so



This close up shot shows the way that AuraSound's speaker uses an array of magnets around the voice coil.

as to cancel standing waves, unwanted boundary reflections, and in particular the primary floor reflection — which Snell rightly claims plays such an important role on your subjective impression of the sound field within a room at low frequencies.

An underlying requirement of the Snell Acoustics system is the need for the retailers, or those involved in marketing this system, to carry out a detailed acoustical assessment of each and every room into which their loudspeakers will ultimately be placed. That assessment in turn will require measurements involving the final location of the speakers (which is a rather vexing issue in itself), in order that all of the relevant information and factors which affect frequency, time domain, and spatial issues can be correctly integrated into the digital electronic module — which will then form part of the Snell speaker system.

Yes, it sounds lovely, and supplemented by the exciting digital software (correctly configured), could well prove to be the most exciting development in room acoustics in the 1990's — particularly if the digital electronics simultaneously linearises the frequency and phase characteristics of the loudspeakers themselves.

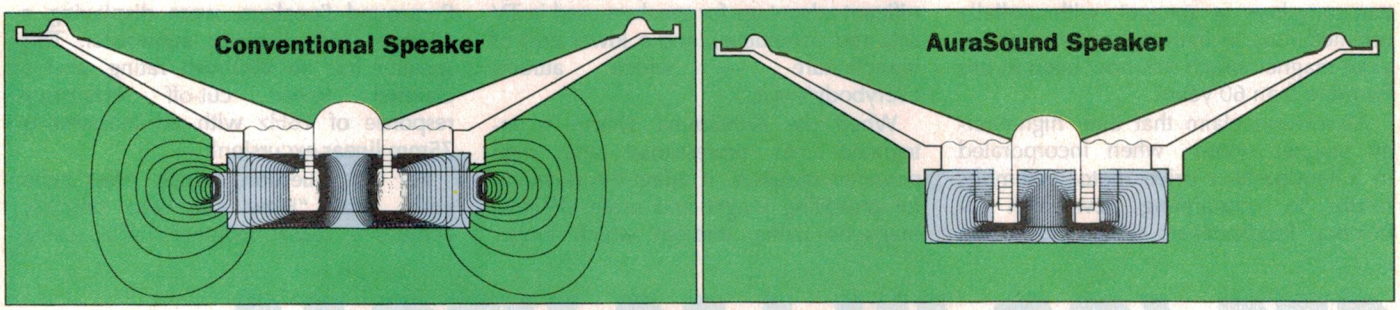
As exciting as the build-up was, the demonstration that I attended proved to be an abject failure. Although the Snell personnel at first tried to gloss over the problems and the fact that I and at least two others in the audience could hear no difference between the normal and electronically corrected signals, they finally had to admit that they had an electronics problem, which had apparently occurred after the first successful demonstrations of the system.

Yes, I know — Murphy won once again, and even though some of the people in the room had 'oohed' and 'aahed' at the demonstration, it was very much a case of the 'emperor's new clothes'. However, I remained stolidly unconvinced, and put it very directly to Kevin Voecks that his system just didn't work. It was only then that he and the other members of staff were prepared to acknowledge to me (privately) that the system had 'packed up', and that there would be no further demonstrations at the CES until the problem was resolved.

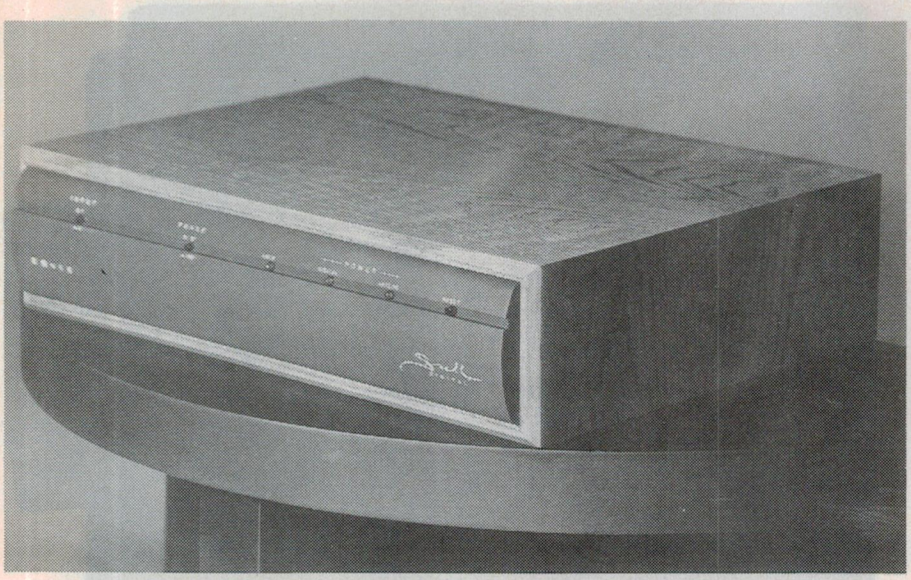
Whilst I didn't hear the system work, others whose opinion I respect had heard it working on the previous day, and they assured me that it *had* achieved precisely what had been claimed for it.

As nice and as esoteric as the concept may appear to be, I foresee a considerable lead time before you can expect to see your favoured speaker salesman drive up to your front door with his complex dedicated digital analyser in order to measure your room's parameters, and subsequently coerce you into irrevocably deciding where your speakers are going to stand — and where you too are subsequently going to sit, in order to derive the full benefits of that system.

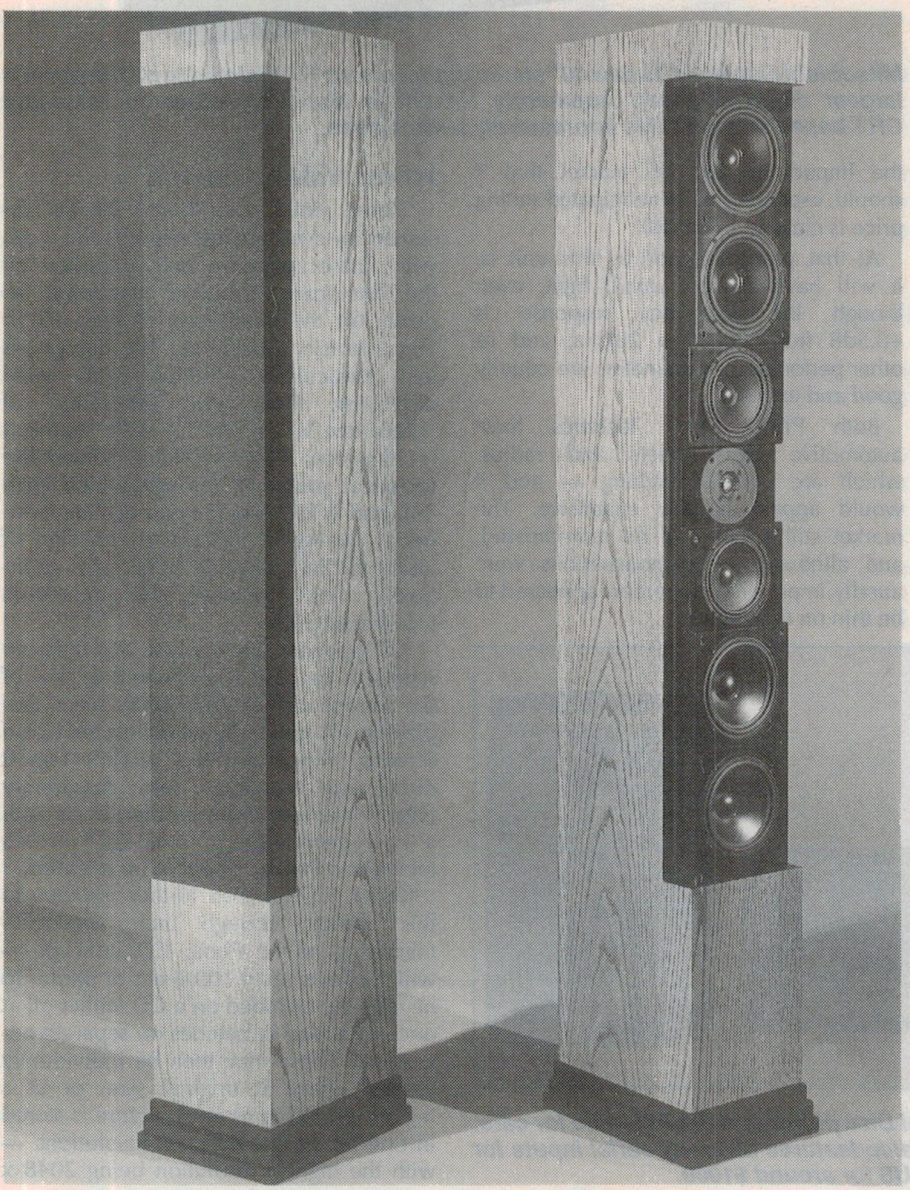
Regrettably the current underlying concept of the Snell Cyberacoustic system is that it will not allow you to make such changes, irrespective of how subtle you may think they may be, without introducing comparable changes to the digital



The construction of AuraSound's 'Radial Flux' speaker compared with that of a conventional speaker. The use of a circular array of magnets around the voice coil gap allows up to 70% less leakage flux than with a conventional type . In addition the new construction results in considerably higher loudspeaker efficiency.



Above and below: Snell Acoustics unveiled its 'Room Acoustics and Loudspeaker Correction' system, which uses digital control to optimise audio performance in a particular room acoustic.



electronics system's parameters in your matching Snell Cyberacoustic electronic equalisation unit.

As an aside, KEF and Bang & Olufsen have been working on a similar system called 'Project Eureka' for the past five years, which aims to achieve generally similar results through a somewhat different technology.

Mini Disc and DCC

Although my friends at Sony may feel that I have been unfair in placing their Mini Disc system fourth in my ranking, having heard (and following my observations of the Mini Disc System at the CES), I nonetheless believe that the Mini Disc will *not* initially prove to have an earth-shattering impact in quite the same way that CD's had when they were released 10 years ago.

Although the Mini Disc system may well prove to be 'mini' in terms of its physical dimensions (for most of the portable units which I saw on the Sony, Aiwa and Sanyo stands), it nonetheless casts a long and somewhat awesome shadow over Philips' DCC (Digital Compact Cassette), with which it is now directly competing in the market place — at least in the United States of America.

Mini Disc players, and more particularly the critical software, went on sale in major US cities in early December. By the time I reached New York at the end of 1992, you couldn't find a Mini Disc player in the shops I visited, although some software titles were still sitting on the shelves in major record shops.

Whilst Mini Disc players were clearly in short supply, you could still find some DCC players on sale at a few of the major retail outlets, and I must acknowledge that Polygram and other major recording software distributors were doing a fine job of ensuring that the record shops had early but limited stocks of DCC software, as well as the equally important blank cassettes.

Aside from the 'hoo ha', many astute reviewers who I met at the CES were already critically asking "Who needs yet another system?", and "What will the fallout be for those poor souls who end up picking the wrong horse, and who may well potentially buy products which could go the same way that Elcassettes and Beta video recorders have already gone?".

Whilst I must pointedly add that I don't really share their concern in this issue, there can be no denying that with a selling price of up to US$14 (i.e., $20 Australian) for a blank Mini Disc, and only a little less for a blank DCC cassette, the public aren't exactly rushing to the shops in the USA to buy either the Mini Disc or DCC systems.

Whilst price plays a clear and obviously critical role, the basic issues involved in this situation are far from simple. Both the Mini Disc and DCC systems offer clear technical advances over the product they both seek to replace. This is the ubiquitous Compact Cassette, which of course I must point out has stood the test of time, and which currently fulfils close to 98% of the user's goals, quite apart from their expectations.

When it comes to absolute fidelity and quality of listening performance, my subjective assessments, backed up by my prior objective assessments, lead me to the conclusion that DCC is clearly superior to Mini Disc. This was confirmed in 'A-B' tests using the same (original) source material for comparison.

The differences in the quality of the sound produced by Mini Disc are most notable on transients, and particularly at higher frequencies.

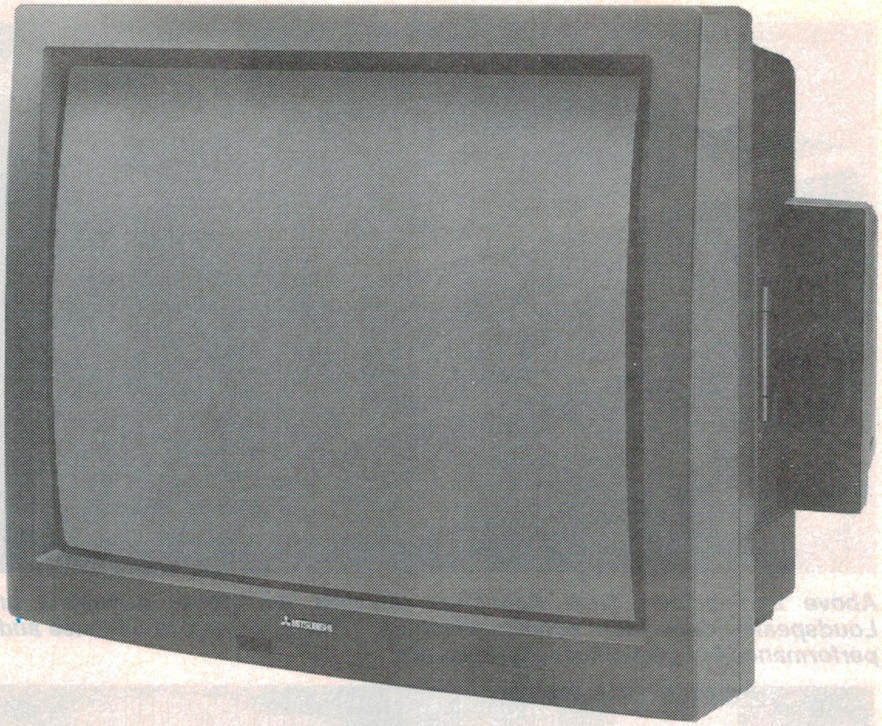
One could liken the differences between Mini Disc and DCC to the differences between Sony's original CDP 101 (the very first CD player on the market) and the better new top-of- the-line one bit or S-bit CD players with multiple oversampling — which exhibit none of the nasty digital filtering characteristics that the first generation of CD players exhibited. But as it appears, the new system is one half of an incremental step worse again!

Sony has placed major emphasis on their automotive Mini Disc player, and their MDX-U1 'detachable face' Mini Disc car tuner has already caught the eye. But it does not yet satisfy the pocket, of even the better-heeled American buying public.

This unit with its diversity aerial inputs, superlative FM tuner and excellent Mini Disc player (but without an integral amplifier) will not necessarily make quite the impact on the US market that it should, especially as its anticipated selling price is close to US$1000.

At that price, as good as this unit is, it will have a nasty uphill fight, even though the frequency response is +0.5dB from 20Hz to 20kHz, and its other performance parameters are equally good and exciting.

Both Philips and Technics have automotive DCC tuners and radios, which are equally exciting — and it would appear equally expensive. The market still appears to be unimpressed, and although the demonstrations were aurally impressive, the orders appeared to be thin on the ground.



Mitsubishi displayed its new 40" stereo digital colour TV, claimed to be the world's largest direct-view set. Apparently Hitachi is also very close to releasing CRT-based sets with this impressively large screen.

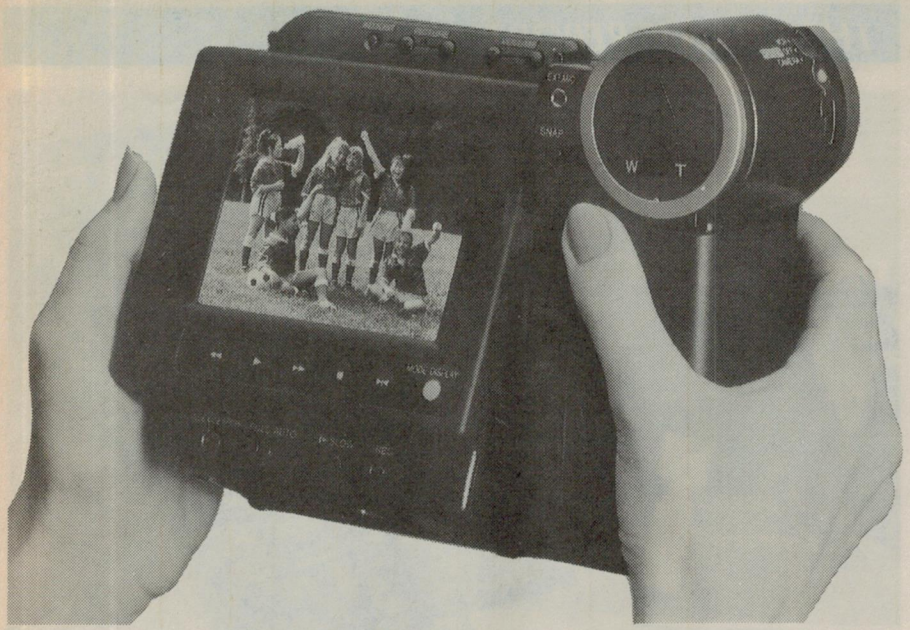
Sony was demonstrating its MDX-U1 Mini Disc player and FM/AM radio for cars. The player has a 'detachable face', and also features diversity aerial inputs for the FM tuner. It is expected to sell in the US for around $1000.

Home video, cinema

'Home video' and 'home theatre' assumed an even greater impetus this year, with further pressure being applied by the American Consumer Electronic Industry for the finalisation of high-definition television standards. The Europeans and particularly Philips (who were displaying their new generation of 'Flickerfree Video Wall' — with 'seamless multi-screen displays'), have solved the technical problems through which both PAL and NTSC systems can display a superior quality of video with no sign of visible flicker, nor nasty black gaps or intrusive lines between the individual monitor screens.

The Japanese approach to this problem seems to be radically different to that of the Europeans, as Mitsubishi were displaying 40" stereo digital colour television screens, which are the world's largest direct-view television sets. Apparently Hitachi are very close on their heels with a new generation of large-CRT screen televisions that are about to be released.

Kodak have added further impetus to this market through their successful marketing of the Photo CD concept — which allows up to 100 slides or photos to be digitally encoded on a CD (either all at once or added in batches on separate occasions). These may then be individually viewed either at original size, or at a higher resolution as each picture is stored in one file at five different resolutions — with the highest resolution being 2048 x



Sharp also attracted plenty of interest with its new VL-HL100U camcorder, featuring as you can see, a 100mm colour LCD viewfinder. The camera section on the right swivels with respect to the rest, for greater flexibility.

3072 pixels, and the lowest resolution 128 x 192 pixels. So you can pick the resolution that suits your needs best. You can then view either the whole of the original photo or enlarged components on your TV set or monitor, using the CDV player.

Whilst Kodak's own CDV player units may be used, so too may those marketed by other manufacturers. Kodak are about to release the ability to add sound and graphics to the Photo CD's, so that you can create a 'talking photo album' — which will create the ability for an older member of the family to create a talking history book. This is truly an exciting concept, and the results could prove to be absolutely sensational.

Although you may consider that the Photo CD system is a trifle gimmicky, I don't view it in that way, and it has is particular relevance if you experience as many problems as I seem to when preparing the 'pick of the photographic crop', to project on those infrequent occasions when the family demands its own personal retrospection. Whilst the Kodak Photo CD system is yet to make its presence felt in Australia, it is making slow but impressive gains in the US market, and that market impact will grow by 'leaps and bounds' when the talking photo albums hit the market.

Camcorders

Sales of miniature video camcorders are going from strength to strength in almost every country in the world. You only have to look at the number of such recorders in the hands of tourists on the street corners of any major city in the world, to realise that these miniature video recorders have really taken the market by storm.

Whilst Sony appears to have the edge on many of its competitors, Canon and Sanyo are now offering equally exciting small units, and Sharp has 'set the market on its head' with its model VL-HL100U. This camcorder, although significantly larger than its competitors, boasts a 100mm colour LCD monitor through which you can actually see what you are recording, and get it right first time. Of course the VL-HL100U has many other exciting features, which include 'Neuro Auto Exposure', infrared remote control, digital image stabilisation and a snapshot function which is most impressive.

This camera really created tremendous interest at the CES, and Sharp were taking an unprecedented number of orders for the camera. Whilst I was using one of Sony's smallest camcorders to capture data and information at the CES, and even though I acknowledge that it performed admirably, there were many occasions during my two days at the show when I would have appreciated the greater flexibility offered by the Sharp 'Direct Viewing Display', in preference to squinting down a little tube in order to view its tiny black and white picture.

Phone/TAM/fax/copier

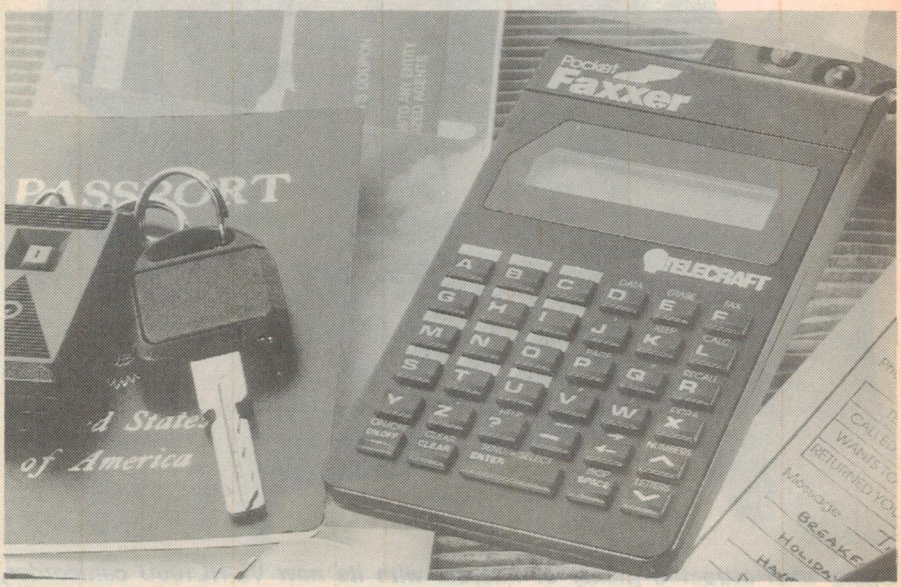
Amongst other products which impressed me at the CES were Sharp's NX-1 Home Fax, which is a combined telephone, telephone answering machine, fax machine, and photo copier. This only requires one telephone line and needs only 250 x 200mm of wall or bench space on which to hang it or place it.

With a US selling price of under $500 and the ability to fulfil three of the four most important functions that every modern yuppy's house requires (phone, answering machine and photo copier), and offering the bonus of a fax transmission and receiving facility for what I perceive to be only a minuscule incremental cost, I predict that large numbers of prospective buyers will be instantly attracted to such a unit.

The Sharp NX-1 Home Fax offers all sorts of other unusual and exciting features, such as its 'pencil free memo pad' function, which allows the user to enter phone numbers on the keypad during a

Sharp was displaying its NX-1 home fax, which combines telephone, answering machine, fax and photocopier. It requires only one telephone line, needs only 250 x 200 of wall or bench space and sells in the US for under $500.

THE CHALLIS REPORT



The Pocket Faxxer from Telecraft is an extremely compact unit which can be used to send faxes. It can also be used as a portable data terminal, electronic organiser and calculator — all for less than US$400.

call, and then dial them at a convenient time later on, using the autodialer (or alternatively to produce a printout for future use). Having recently spent half of that prospective cost on a new quality Telecom phone answering machine, I believe that products offering such multi-functional capabilities are a 'sure fire' winner.

Whilst on the subject of faxes, I was equally impressed by a new 'Pocket Faxxer' from Telecraft through which you can create, edit and send typewritten fax messages to a line or even send messages directly to radio pager.

The Pocket Faxxer can be used as a portable data terminal, or as a Databank, or as a telephone dialler, as well as functioning as an Electronic Organiser to provide multi-alarm message reminders. As if that weren't enough, it also functions as a nine digit, four-function calculator — and all of this for a retail price of less than US$400.

Filtering cable

Whilst there were loads of other exciting and innovative products on display, I will only recount one more which was noteworthy — and not because of its technical excellence, but rather because it goes against the grain of what you or I have come to accept on the basis of our prior experience and teaching.

Each year the CES has a number of products which fit this category. This year's prizewinner was Audio Interface Networks' Constant Velocity Transmission Cable, which is more than just a cable as it incorporates both high pass and low pass filter networks in order to provide what the manufacturer claims is 'improved sonic performance' and 'better transient response' — so that you will benefit by way of 'more music'.

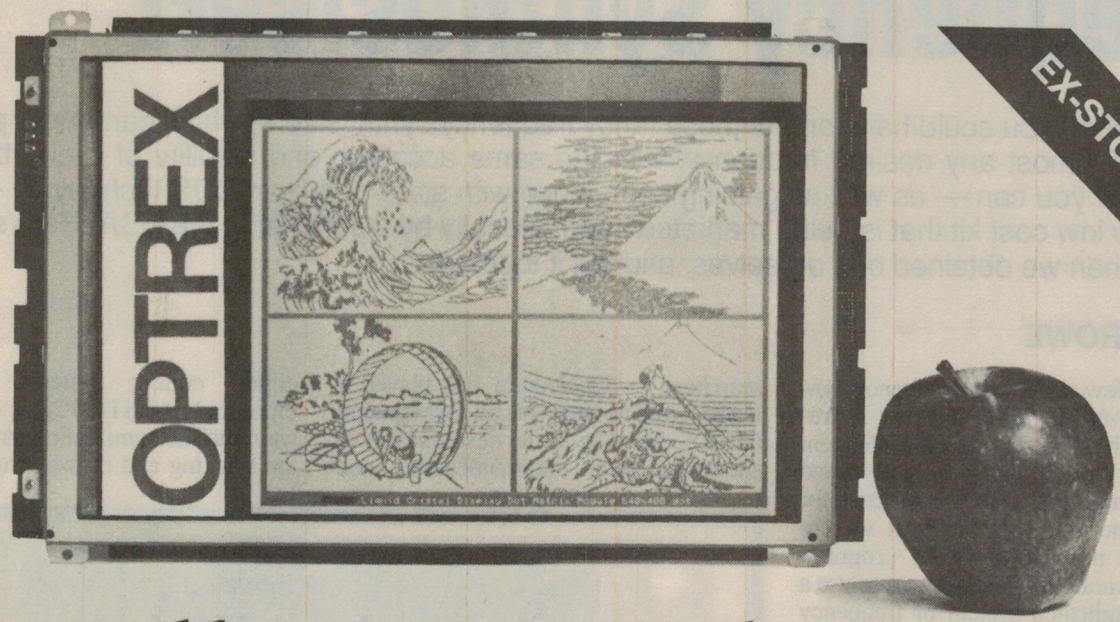
The Constant Velocity Transmission Cable apparently attenuates all of the frequency components outside the normal audible range, so as to ensure that you are not subjected to frequency components 'which you did not want to hear', which were presumably artefacts and not part of the original recording.

I felt tempted to discuss the practicalities and theoretical issues underlying this product with the people on the stand. As I soon discovered, they seemed to have all the catch phrases and buzz words for selling the product, but seemed to know very little about the theoretical issues involved, and I quickly withdrew from further involvement.

Whilst this product cannot be categorised in quite the same class as 'green felt pens' which you can apply to your CD's and which were in vogue a year or so ago, there are plenty of purchasers who will buy this product and who will undoubtedly 'sing its praises from the roof tops'.

Las Vegas had a myriad of other exciting, interesting and even avant-garde products to offer the ingenuous, the intrepid and the experienced visitor. What I have endeavoured to describe will give you some clues as to where the market is going, and the type of development that you can expect to see in our market in the forthcoming year. ❖

For the widest choice in LCD DISPLAYS



...call Amtex Electronics

GRAPHIC TYPE MODELS WITH BUILT-IN CONTROLLERS				
Dot pixels	**Type No.**	**Module dimensions**	**Viewing area**	**Backlighting**
128 x 112	DMF-5002N	110 x 91 x 13mm	77 x 66mm	None or EL
160 x 128	DMF-5001N DMF-5003N-FW	129 x 102 x 13mm 152 x 112 x 23mm	101 x 82mm 101 x 82mm	None or EL C.C.T.
240 x 64	DMF-5005N DMF-5010N-FW	180 x 65 x 12mm 200 x 66 x 23mm	132 x 39mm 132 x 39mm	None or EL C.C.T.

All models above have a built-in control LSI T6963C. This eliminates the need to design your own controller board to drive the LCD.

There is a choice of No backlighting (Reflective type), Electro-Luminescent or Cold Cathode Tube backlighting.

Other GRAPHICS models you can choose from range from 128 x 64 dots, to 720 x 480 dots.

In the ALPHANUMERIC range, models are available from 16 characters x 1 line, to 40 characters x 4 lines. And you have a choice of character sizes and backlighting (EL or LED type).

And for really large volume users, you can even choose to have a display custom designed.

Applications

- Medical instrumentation
- Computer equipment
- Industrial & factory automation
- Telecommunication instruments
- POS Terminals
- Hand-held data terminals
- Test & measurement instruments
- Office automation equipment
- Automotive test instruments
- Portable data loggers

OPTREX CORPORATION

the world's largest LCD manufacturer, is a joint venture between Mitsubishi Electric and Asahi Glass.

The choice is yours... but you'll have to call Amtex to make it.

AMTEX ELECTRONICS

READER INFO NO. 2

13 Avon Road, North Ryde 2113
Tel: (02) 805 0844 Fax: (02) 805 0750

Low cost DDS kit from the USA lets you...

Build your own 0-12MHz Frequency Synthesiser!

Ever wished you could have one of those fancy frequency synthesisers, which can easily produce a signal of almost any desired frequency, with the same accuracy and stability of a quartz crystal? Well, now you can — as well as gaining experience with state-of-the-art DDS technology — thanks to a new low cost kit that is being marketed internationally by a supplier in the USA. Here's what we found when we obtained one ourselves, and put it together...

by JIM ROWE

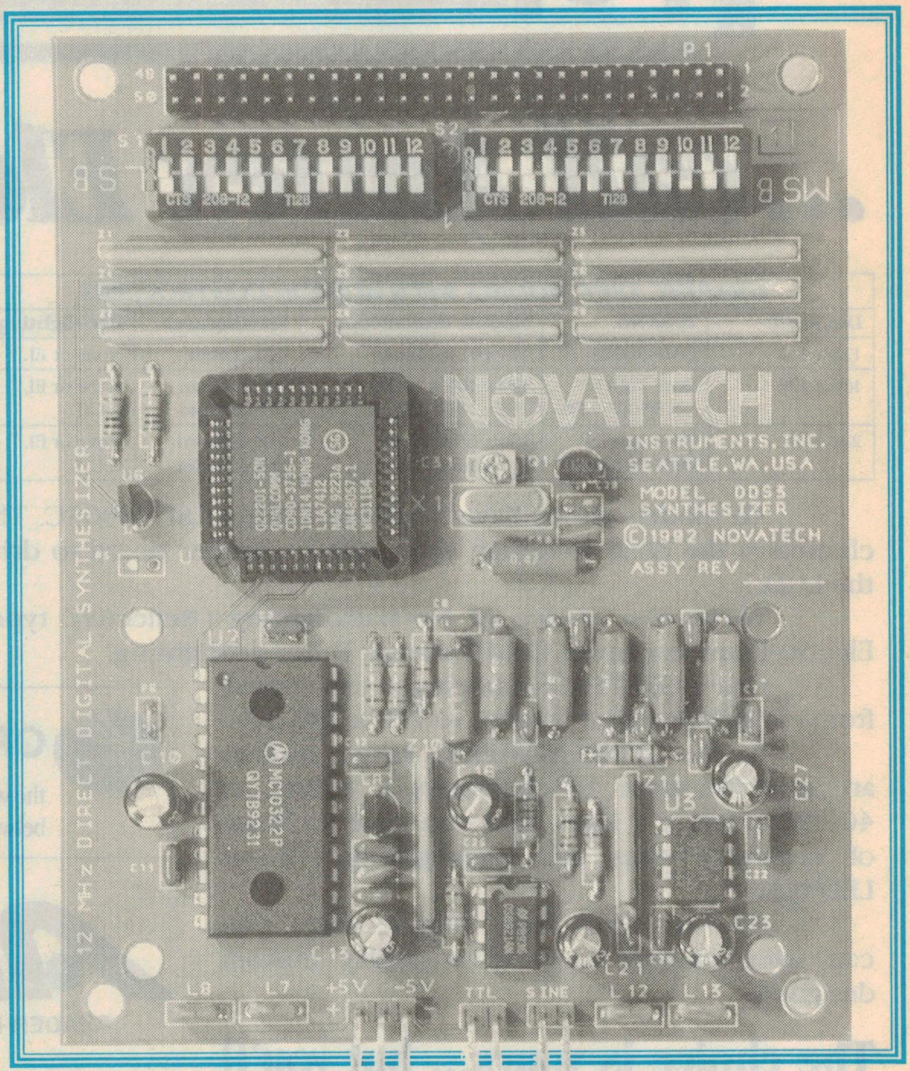
Until a few years ago, frequency synthesisers were big and complex instruments, with a price tag which made them affordable only by the most well-heeled R&D laboratories. This was because for a long time, the only practical way to synthesise a wide range of programmable, accurate frequencies was to use a fairly complicated system of frequency dividers, multipliers, mixers and phase-locked loops.

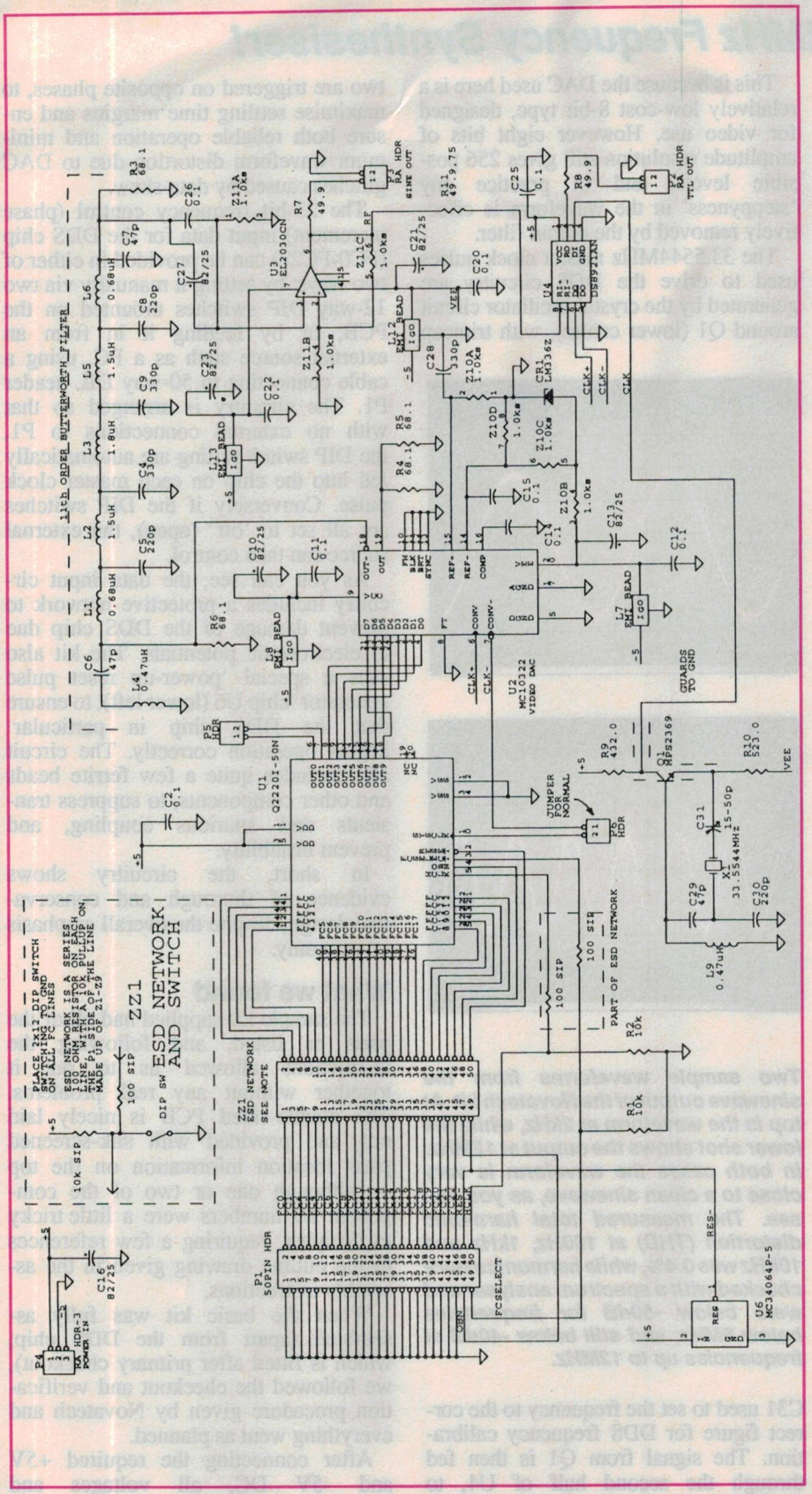
More recently, though, this has all changed with the development of *direct digital synthesis*, or 'DDS'. As the name suggests, this is a technique which uses digital circuitry to directly synthesise a signal at the desired frequency, from a single master clock frequency. In effect, a DDS forms a digitally programmable frequency divider, with its division ratio variable over a very wide range and with the ability to produce a low-distortion sinewave output signal.

A big advantage of the DDS approach is that virtually all of the circuitry required for the digital side of its operation can be integrated into a single VLSI chip.

It's this aspect that is causing so much interest in the technique, because a one-chip frequency synthesiser has great potential for things like handheld transceivers, cellular telephones, spread-spectrum radio and many of the other new and burgeoning communications systems.

One of the firms that has been in the forefront of international DDS development is Qualcomm Inc, based in San Diego, California. Founded only eight years ago (1985) by Drs Irwin Jacobs and Andrew Viterbi — both internationally recognised communications researchers — Qualcomm has played a leading role not only in the development of DDS, but also in the development of spread-spectrum communications and digital coding systems. Qualcomm pioneered OmniTRACS, a mobile two-way satellite communications system for the trucking and railway industries, and





Here's the schematic for the Novatech 12MHz frequency synthesiser kit, which is based around the Qualcomm Q2220 DDS chip. 50-pin header P1 is for interfacing to a computer — note however, that the connections for frequency control inputs FC0-FC22 are shown here in reverse order. FC0 actually connects to pin 46, FC1 to pin 44, and so on,with FC22 connecting to pin 2. We discovered this error ourselves — the hard way. (Diagram courtesy Novatech.)

more recently has developed the CDMA system for digital cellular phones — which is causing something of a re-think among the world's telecomm authorities. The firm has also been awarded a big contract by the US Defense Advanced Research Projects Agency (DARPA), for the development of HDTV.

But what has all this to do with Novatech's low-cost frequency synthesiser kit? Well, early last year Qualcomm announced a new low cost DDS chip, the Q2220. This comes in a 44-pin PLCC (plastic leadless chip carrier) package, and will operate with clock signals up to 50MHz — so that it can be used to produce synthesised signals up to about 20MHz.

Q2220 chips and even evaluation kits have actually been available here in Australia for some months, from Qualcomm's local distributor Veltek. However the quoted price has been fairly high, with the evaluation kit at around A$550.

The situation changed a short time ago, however, when a much lower cost evaluation kit based on the same Q2220 DDS chip was announced by Novatech Instruments Inc — a kit supplier based in Seattle, Washington, and one which is keen to attract overseas mail-order business.

Novatech's DDS3 Synthesiser Kit is very similar to Qualcomm's own evaluation kit; but by using a lower cost video DAC and pulling a few other tricks, Novatech has been able to prune the price down to only US$119.95 plus US$10 for packing and shipping. Even at Australia's currently low exchange rate of around A$1 = 65 US cents, this still means that you can get the Novatech DDS3 kit for the equivalent of only A$200 — much lower than the Qualcomm kit.

The Novatech kit assembles on a PCB measuring only 89 x 115mm, and uses a 33.5544MHz crystal to drive the Q2220 chip (as does the Qualcomm kit). This allows it to produce any frequency between 2Hz and 12MHz, with a resolution of 2Hz (i.e., adjustable in steps of 2Hz). It produces both sinewave and squarewave (TTL compatible) outputs, simultaneously, and the sinewave output is approximately 1.4V p-p into a high impedance, or 0.7V p-p into 50 ohms. The output frequency is set by programming a 23-bit digital input, using either a set of DIP switches on the board, or an off-board source of parallel 23-bit TTL/CMOS words and a strobe pulse — from, say a PC with a suitable interface.

Despite the kit's low cost, the sinewave output is very clean over most

Build your own 0-12MHz Frequency Synthesiser!

of the frequency range, with spurious and harmonic outputs at least 50dB below the main output up to 5MHz, and at least 40dB down up to 12MHz. In short, the Novatech DDS kit provides the heart of a complete and very practical DDS-based 12MHz frequency synthesiser.

Needless to say as soon as we heard about the new kit, we lost no time in contacting Novatech by fax. It turned out that they are very keen to attract orders from Australia, and were happy to send us a DDS3 kit so that we could try it out and report our results. And that's the background to this article. (I'll tell you how to obtain the kit later, by the way...)

Incidentally if you're not as yet acquainted with DDS technology and would like to know a little more about the way they work, I've prepared an explanation which will hopefully help. You'll find it in the accompanying article.

Circuit details

The circuit for the Novatech DDS3 is shown in Fig.1, reproduced from the eight-page A4 assembly instructions supplied with the kit itself.

As you can see, the Q2220 DDS chip which forms the heart of the circuit is U1, with its output feeding to video DAC U2 — a Motorola MC10322 device. The raw sinewave analog output waveform produced at pin 18 of the DAC is then passed through an 11th-order Butterworth LC low-pass filter (upper right), which has a cutoff frequency of around 12MHz and very steep rolloff. This removes aliases and other spurious components, to produce a clean output waveform.

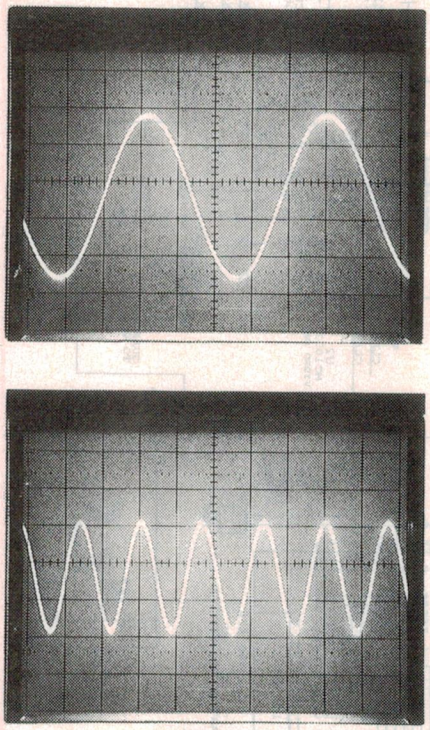
After filtering, the signal is passed through U3, an EL2030CN (or AD811AN) high-speed buffer amp configured to give a gain of two and high bandwidth. The output of U3 is then fed to the 'sinewave output' connector P3, via a 50-ohm (or 75-ohm if desired) series resistor.

To produce the TTL-level squarewave output, the signal from U3 is also passed through half of U4, a DS8921AN dual high-speed comparator. The squared output from pin 2 is then fed to the 'TTL output' connector P2, again via a 50-ohm or 75-ohm series resistor.

Note that although the Q2220 DDS chip actually provides 10-bit waveform samples via pins 6-9 and 13-18 (OUT0-9), only the eight most significant bits are fed to the DAC.

This is because the DAC used here is a relatively low-cost 8-bit type, designed for video use. However eight bits of amplitude resolution still gives 256 possible levels, and in practice any 'steppyness' in the waveform is effectively removed by the output filter.

The 33.5544MHz master clock pulses used to drive the DDS circuitry are generated by the crystal oscillator circuit around Q1 (lower centre), with trimcap C31 used to set the frequency to the correct figure for DDS frequency calibration. The signal from Q1 is then fed through the second half of U4, to produce bipolar TTL-level clock signals to drive both the DDS chip U1 and the DAC U2.



Two sample waveforms from the sinewave output of the Novatech kit. At top is the waveform at 2kHz, while the lower shot shows the output at 12MHz. In both cases the waveform is very close to a clean sinewave, as you can see. The measured total harmonic distortion (THD) at 100Hz, 1kHz and 10kHz was 0.4%, while harmonics were checked with a spectrum analyser and were below -50dB for frequencies below 5MHz, and still below -40dB at frequencies up to 12MHz.

The latter uses both clock polarity signals, while the DDS chip itself uses only one. The circuitry is arranged so that the two are triggered on opposite phases, to maximise settling time margins and ensure both reliable operation and minimum waveform distortion due to DAC glitches caused by data-skew.

The 23-bit frequency control (phase increment) input data for the DDS chip (FC0-FC22) can be provided in either of two ways: by setting it manually via two 12-way DIP switches mounted on the PCB, or by feeding it in from an external source such as a PC, using a cable connecting to 50-way DIL header P1. The circuitry is arranged so that with no external connections to P1, the DIP switch setting are automatically fed into the chip on each master clock pulse. Conversely if the DIP switches are all set to 'off' (open), the external source can take control.

As you can see, the data input circuitry includes a protective network to prevent damage to the DDS chip due to electrostatic potentials. The kit also uses a special 'power-up reset pulse generator' chip U6 (lower left), to ensure that the DDS chip in particular begins operation correctly. The circuit also includes quite a few ferrite beads and other components, to suppress transients and spurious coupling, and prevent instability.

In short, the circuitry shows evidence of thorough and conservative design, despite the overall emphasis on economy.

What we found

The sample kit supplied had all of the parts as listed, and following the instructions allowed us to put it together without any real problems. The double-sided PCB is nicely laid out, and provided with silk-screened parts location information on the top — although one or two of the component ID numbers were a little tricky to decipher, requiring a few references to the outline drawing given in the assembly instructions.

When the basic kit was fully assembled (apart from the DDS chip, which is fitted after primary checkout), we followed the checkout and verification procedure given by Novatech and everything went as planned.

After connecting the required +5V and -5V DC, all voltages and waveforms checked out as they should, and the crystal oscillator trimmed to the correct frequency of 33.554432MHz without any hassles.

We were then able to fit the DDS chip itself, and fire up the synthesiser in

earnest. It sprang to life exactly as expected, and we were soon generating sinewaves and squarewaves of any frequency we wished, on any multiple of 2Hz between 2Hz and 12MHz or so. (You can actually go beyond 12MHz if you wish, but the amplitude falls away fairly significantly due to the low-pass filter rolloff, and spurious levels rise...)

We checked the sinewave output waveform carefully with a 100MHz scope, over a variety of frequencies in the available range, and it was generally very clean.

There was a very tiny 'dent' at the very top of the positive half-cycle, evident at all frequencies, but this may have been due to a slight unbalance of the sample kit's DAC reference circuitry. A *very* small amount of waveform steppyness was also evident at some frequencies near the low end, but not enough to be of any real concern.

We also checked the sinewave output with a low-cost HF spectrum analyser probe (the Smith Design VOS-107, reviewed in November 1990), to see if we could verify the rated performance in terms of spectral purity. The levels of any non-harmonic spurious outputs (including the 33MHz clock) appeared to be generally more than 55dB below the main output, although they occasionally came up a little higher as you approached 12MHz.

Similarly harmonics of the main output appeared to be down by the rated -50dB below 5MHz, and still below the rated -40dB at frequencies up to 12MHz.

We weren't able to make a measurement of the phase noise level (rated at better than -90dBc at 1kHz offset), but our general observations upon tuning around the output with an HF communications receiver were that it was quite 'clean'.

The frequency stability also appeared to be very good, considering that the 33MHz crystal clock oscillator is just a standard on-board type and not in an oven.

Summary

In short, then, the sample Novatech DDS3 kit appeared to work exactly as it should. Our impression therefore is that the DDS3 provides an excellent way to obtain a good, modern DDS-based 12MHz frequency synthesiser module, at a very attractive price.

By the way, the DDS3 printed circuit board has additional 3.5mm holes around the DAC, filter and output circuitry, so that if you wish you can fit shields both above and below the board to minimise leakage.

This would probably make it feasible to feed the output through a reasonably serious attenuator, to turn the DDS3 into a more complete signal generator.

Of course if the assembled DDS3 synthesiser module is used by itself, you still have the inconvenience of having to program the desired output frequency in binary, using the DIP switches.

The obvious way around this would be to use an 'intelligent user interface' of some sort, to accept and display your desired frequency in decimal, and automatically feed the corresponding binary code to the synthesiser module.

You could doubtless design a dedicated microcontroller board to do this, making a complete free-standing equivalent to the expensive lab synthesisers.

However after assembling the DDS3 kit and checking it out, I'm working on a slightly different and easier approach: using a PC to provide the user interface, running suitable software and communicating with the DDS module via a modified version of the low cost serial I/O interface I described in the July-August 1991 issues. This is looking very promising, so stay tuned for details soon!

If I've whetted your appetite, you're no doubt waiting now for one remaining bit of information: how *you* can get a DDS3 kit for yourself. It's simple, because all you have to do is mail your order (with payment) to Novatech Instruments, 1530 Eastlake Avenue E., Suite 303, Seattle WA 98102, USA.

The price of the DDS3 kit is US$119.95 plus US$10 for handling and shipping, giving a total of US$129.95.

Novatech understandably prefers to get this payment as a bank cheque or money order in US currency, but they've advised me that they will also accept bank cheques in Australian currency — providing they are made out for a figure to cover the exchange rate conversion.

This means that as the current exchange rate is around 65 US cents for A$1.00, and drooping, you'll really need to send a cheque for around A$200 to make sure Novatech ends up with the right amount. That's all there is to it.

In closing, my thanks to Mr Bob O'Brien, Novatech's marketing manager for his help in arranging our review of the DDS3 kit. It isn't often that we get a chance to review a kit from a US supplier — let alone an exciting state-of-the-art one like this. ❖

Technology update:

How a DDS works, and inside the Q2220

In this issue you'll find a review of an exciting new kit, available from US supplier Novatech Instruments, for a low cost 12MHz frequency synthesiser based on a direct digital synthesiser or 'DDS' chip. As DDS technology is quite new, and many readers may not as yet be familiar with the principles involved, this seems like a good opportunity to provide a quick rundown on the way a DDS works. We also take a look inside the Qualcomm Q2220 DDS chip, used in the new kit.

by JIM ROWE

As you might expect from the fact that it's based on digital technology, a DDS takes advantage of the principle of *digital sampling* — representing an analog signal by a sequence of digital samples, each of which is a binary number. These can be fed through a digital-to-analog converter or 'DAC', to recreate the analog signal. If this all sounds familiar, it should: it's exactly the same technique used in a CD player.

Now consider the following simplified example. Let's say we have a pure sinewave signal of 1Hz, and we take digital samples of one full cycle with an analog-to-digital converter (ADC), running at a conversion clock rate of say 1MHz. This will take a full second, and produce one million samples — each a digital number corresponding to the amplitude of the sinewave at each sampling instant. Since we've taken a million samples to capture a single period of our sinewave, adjacent samples will differ by only ($360°/10^6$), in terms of the sinewave's phase.

Let's say we store all of these digital samples in a big ROM chip, in the correct sequence, and connect the output pins of the ROM to a DAC. We then use a 1MHz clock signal, fed to an address counter, to cycle the ROM through all of its addresses in sequence.

What will come out of the DAC? Fairly clearly, we'll get a very good re-creation of our original 1Hz sinewave. There will be a certain amount of 'clock noise' at 1MHz and its harmonics, but this can be filtered out fairly easily. If we keep cycling the ROM through its address range over and over again, we'll get a continuous 1Hz sinewave.

Now for the interesting part. How can we use this system, with its sinewave stored as a set of digital samples, to generate other frequencies — say 2Hz, or 5Hz, or 20Hz?Perhaps the most obvious way would be simply to change the frequency of the clock signal used to step the ROM through its addresses: a 2MHz clock would give us 2Hz, a 5MHz clock 5Hz, a 20MHz clock 20Hz and so on. But this would mean that whatever output frequency we wanted, we'd need a matching clock frequency one million times higher — our system would be little more than a very fancy frequency divider, with a fixed division ratio of 10^6:1...

There is *another* approach, as it happens. This is to keep our 1MHz clock signal, for stepping through the ROM addresses, but vary instead the *address increment* that occurs on each clock pulse.

Until now, we've been assuming that the ROM address is simply generated by a counter, and incremented by one, for each clock pulse. Hence each clock pulse causes the ROM/DAC combination to 'move forward' by one millionth of the sampled sinewave's cycle, so that it takes a full one million clock pulses to step through the complete sinewave cycle. But what if we change the ROM addressing system, so that instead of incrementing the address by *one* on each clock cycle, we increment it by *two*?

Fairly obviously, this will effectively move the ROM forward by *two* millionths of a cycle on each clock pulse. So we'll now move through the ROM addresses *twice as fast*, and take only half the time to move through the full address

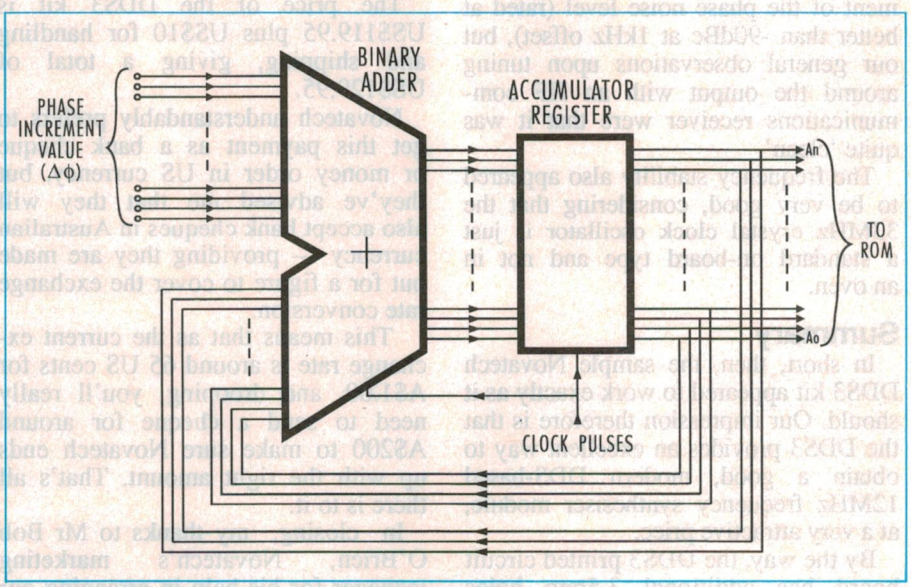


Fig.1: To 'replay' the waveform samples stored in its ROM at any desired frequency, a DDS must be able to 'step through' the samples in corresponding multiples. This is done using a phase accumulator, shown here.

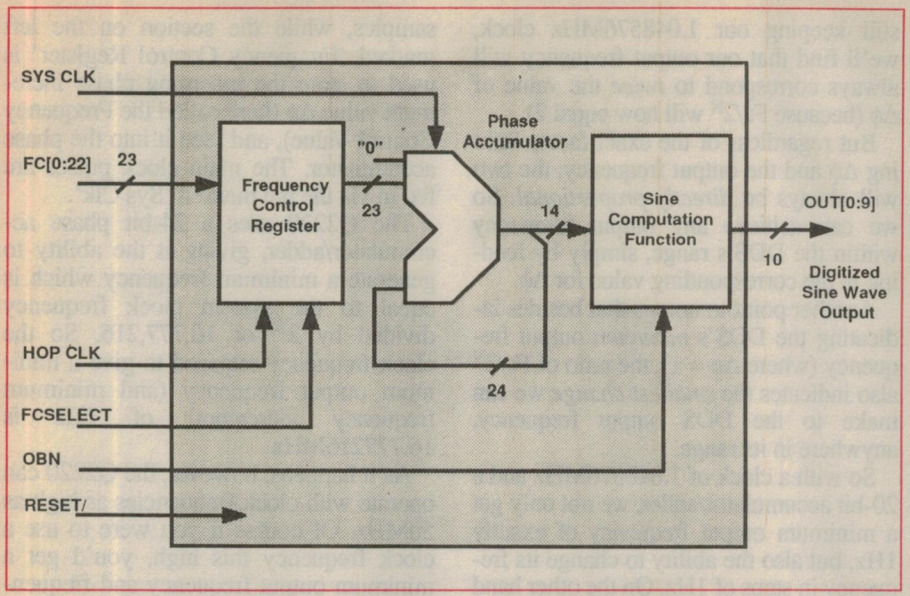


Fig.2: The block diagram given by Qualcomm for its Q2220 DDS chip. The section in the centre marked 'phase accumulator' corresponds to the logic shown in Fig.1. The 'sine computation function' contains the stored waveform samples.

range. The end result is that we'll now be generating a 2Hz sinewave — and still from our unchanged 1MHz clock...

Similarly if we arrange for the ROM address to be incremented by *three* on each clock cycle, we'll end up with an output sinewave of 3Hz; and if we increment it by 20 on each clock cycle, we'll end up with a 20Hz sinewave. We can even get an output frequency of say 3127Hz, simply by arranging for the ROM address to be incremented by 3127 on every clock cycle. All of these frequencies can be produced with the same clock frequency of 1MHz, too.

See the pattern? This basic system allows us to produce sinewaves of virtually any desired frequency, over a wide range and from a fixed clock frequency, simply by varying the size of the address increment that occurs on each clock pulse. The output frequency is in fact directly proportional to the value of the address increment, because of the way each original ROM address increment corresponds to a certain *phase increment* in the sampled waveform.

This, then, is the basic idea of DDS. It's a system of having a set of digital samples for a sinewave stored in a ROM, with a special addressing system so that the ROM can be cycled through its addresses at any desired rate, by varying the value by which the address is incremented on each fixed-frequency clock pulse. The ROM sample data is then fed into a DAC, to produce the desired output sinewave.

As you can hopefully see, it's a pretty nifty way to synthesise signals over a wide range of frequencies. But are there any limitations? Yes, of course — nothing is perfect, in the real world. One problem is that the output of the DAC contains components introduced by the sampling clock, as we've already noted. This means that the output of the DAC has to be fairly well filtered, using a low-pass filter with its cutoff frequency just above the highest output frequency.

Another limitation is that the sampling *resolution* of the reconstructed sinewave decreases as the frequency is increased. This is because as the address/phase increment value is increased, to increase the output frequency, the number of ROM samples used to produce each cycle of our output sinewave is *reduced*.

Note that in our simple example, only 500,000 samples will be used to produce each cycle of the 2Hz output, instead of the one million used to produce 1Hz; and only 200,000 samples/cycle will be used to produce 5Hz. When we want to produce an output frequency of say 10kHz, there will be only 100 samples/cycle; if we want to produce 100kHz, there will be only 10 samples/cycle.

Because of this reduction in resolution, the reconstruction of our output sinewave will be more and more approximate as the frequency rises. The limit will come at an output frequency of half the clock frequency (i.e., here 500kHz), where we'll end up with only two samples per cycle: giving an output that has ceased to be even an approximation of a sinewave, and is now a squarewave. (If you remember your digital sampling theory, half the sampling clock frequency is in fact Nyquist's limit.)

What this means is that in practice, the output of the DAC has increasing harmonic content (mainly odd harmonics), as we approach the limit of half the clock frequency.

To remove these harmonics and maintain a reasonably clean sinewave output, the cutoff characteristic of the low-pass filter at the output of the DAC must be made quite steep. In practice it's usually designed for a cutoff frequency at around 40% of the clock frequency, and given as steep a cutoff slope as possible.

Varying the increment

By this stage, you're perhaps wondering how we can arrange an addressing system for the ROM, so it can be incremented by any desired value for each clock pulse. Fairly clearly this is a crucial part of the way a DDS works, but at the same time it obviously calls for something a little more complex than a simple counter...

The way it's done is by using a *binary accumulator*, consisting of a storage register and a parallel binary adder, as shown in Fig.1. The accumulator register is basically a set of flipflops, where the number of flipflops must be sufficient to provide the required maximum number of ROM sample addresses, in binary. As with any other binary addressing scheme, this addressing capability follows a simple 'powers of two' law: N flipflops, giving N address bits, will be able to provide addressing for 2^N samples.

Using our simple DDS example again for illustration, there's actually no power of two which corresponds exactly to a decimal million. But if we increase our number of ROM samples slightly to 1,048,576 (with the clock frequency changed also to 1.048576MHz), we would need an accumulator register with 20 flipflops, to provide the necessary 1,048,576 addresses (because 2^{20} = 1,048,576).

The binary adder ahead of the register has to have the same 'width' as the register itself, for correct operation. So for our simple DDS with a 20-bit accumulator, we'd need a binary adder capable of adding together two 20-bit numbers, and producing a 20-bit output.

As you can see, the output lines of the adder are connected to the data inputs of the accumulator register, while one of its sets of inputs are fed in turn from the *outputs* of the accumulator.

The other set of adder inputs are used to feed in a binary number corresponding to the desired ROM address incrementing value, for the frequency we want to generate. This number is usually called the *phase increment value*, and is symbolised by $\Delta\phi$. Numerically, it turns out to

How a DDS works

be directly proportional to the output frequency, because:

$Fo = (Fc/2^N) * \Delta\phi$

where Fo is the output frequency, Fc is our clock frequency and N is the number of bits in the accumulator register.

To make this clearer, consider what happens with our 20-bit accumulator and 1.048576MHz clock frequency. If we give our input $\Delta\phi$ number the value of one (i.e., a 20-bit binary number with 19 zeroes, and one '1' in the least significant place), what will happen is that each clock pulse will cause the adder to take the current number in the register, add one to it, and load it back into the register. This means we'll get ROM address incrementing by one, and the DAC will produce our original 1Hz sinewave.

If we now change the value of our $\Delta\phi$ number to the binary equivalent of say 20, the adder will now add 20 to the current accumulator content, for each clock pulse, and our ROM addresses will now be incremented by 20 instead of one.

As a result, our output frequency will become 20Hz. Similarly if we make our $\Delta\phi$ number say the binary equivalent of 15,625, this will become the incrementing value for our accumulator, and the output frequency will become 15.625kHz.

Note that in this simplified example, our accumulator addressing range (2^N) and clock frequency *happen* to be the same — so that ($Fc/2^N$) is unity. That's why the value of our $\Delta\phi$ input number is corresponding directly to the resulting output frequency.

However this doesn't have to be the case; if we use an accumulator and adder of only 19 bits instead of 20 bits, while still keeping our 1.048576MHz clock, we'll find that our output frequency will always correspond to *twice* the value of $\Delta\phi$ (because $Fc/2^N$ will now equal 2).

But regardless of the exact factor linking $\Delta\phi$ and the output frequency, the two will always be *directly proportional*. So we can achieve any output frequency within the DDS's range, simply by feeding in the corresponding value for $\Delta\phi$.

Another point to note is that besides indicating the DDS's *minimum* output frequency (where $\Delta\phi = 1$), the ratio of $Fc/2^N$ also indicates the *smallest change* we can make to the DDS output frequency, anywhere in its range.

So with a clock of 1.048576MHz and a 20-bit accumulator/adder, we not only get a minimum output frequency of exactly 1Hz, but also the ability to change its frequency in steps of 1Hz. On the other hand changing to a 19-bit accumulator/adder with the same clock frequency not only raises our minimum output frequency to 2Hz, but also means that we can only change the frequency in 2Hz steps.

Hopefully this explanation will have given you at least a basic idea of how a DDS operates. Now let's look quickly inside the Qualcomm Q2220 DDS chip, a state-of-the-art VLSI device which forms the heart of the new frequency synthesiser kit.

Inside the Q2220

The block diagram given by Qualcomm for their Q2220 chip is shown in Fig.2, and the section in the centre labelled 'Phase Accumulator' consists of *both* the adder and accumulator register sections we've discussed in Fig.1. The section on the right marked 'Sine Computation Function' is essentially the ROM containing the digitised sinewave samples, while the section on the left marked 'Frequency Control Register' is used to store the incoming phase increment value $\Delta\phi$ (here called the Frequency Control Value), and feed it into the phase accumulator. The main clock pulses are fed in via the pin marked 'Sys Clk'.

The Q2220 uses a 24-bit phase accumulator/adder, giving it the ability to generate a minimum frequency which is equal to the system clock frequency divided by 2^{24} or 16,777,216. So the clock frequency required to give a minimum output frequency (and minimum frequency increment) of 1Hz is 16.777216MHz.

As it happens, however, the Q2220 can operate with clock frequencies as high as 50MHz. Of course if you were to use a clock frequency this high, you'd get a minimum output frequency and frequency increment of 2.9802322Hz, which would not be all that useful for many applications. In practice the most convenient clock frequency to use for many applications is 33.554432MHz, which gives a minimum frequency and frequency increment of exactly 2Hz. This is in fact the clock frequency used in the Novatech kit.

If you've examined Fig.2 carefully, there are probably a few points that you'd like explained further. For example, why does the Q2220 only have 23 bit lines for the Frequency Control input, when it has a 24-bit accumulator/adder?

This is because there's no point in bringing out the 24th and most significant input bit. It would only be needed (i.e., set to a '1') for phase increment values corresponding to output frequencies of greater than half the clock frequency, and as the maximum output frequency is limited in practice to around 40% of the clock frequency, the sensible approach is to set this input bit of the adder permanently to a '0' inside the chip — as shown.

You've probably also noticed that although the Q2220's phase accumulator has 24 bits, only 14 of these (the 14 most significant, in terms of binary weighting) are actually used to control the addressing of the 'sine computation function' ROM. How can we simply discard 10 of the accumulator's bits, when they seemed to be all necessary for DDS operation and sweeping through the ROM's waveform samples?

The answer to this is that the full 24 bits are really only necessary in the phase accumulator — to achieve the correct relationship between the DDS's clock frequency, its frequency control input value and the minimum output frequency/frequency step. We're not forced to use all of

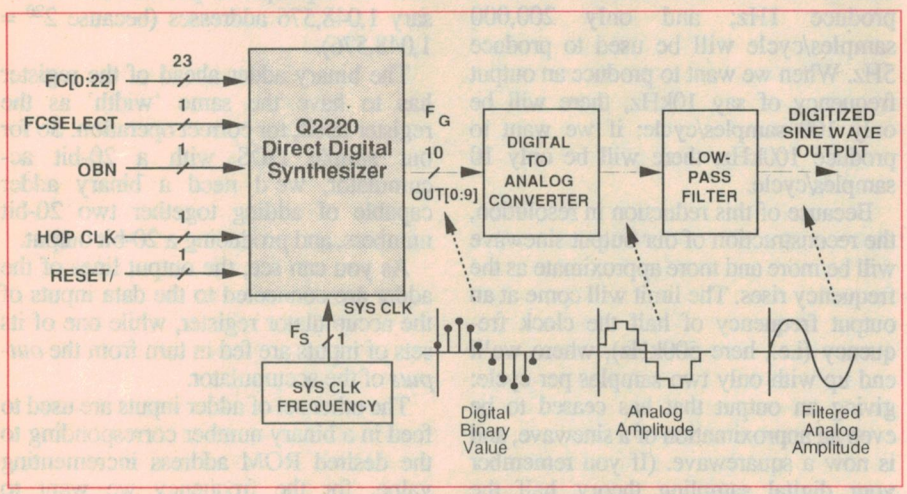


Fig.3: To produce a complete digital frequency synthesiser, the Q2220 DDS chip output is fed to a digital to analog converter and then through a low pass filter. The system clock frequency can be as high as 50MHz.

these bits for ROM addressing — and this is just as well, as this would call for a ROM with an extremely large number of waveform sample addresses, if we did. Remember our simple DDS example, with over a million waveform samples?

As it happens, the full range of ROM waveform samples is only used to generate the waveform for the *lowest* DDS output frequencies. And once you are using more than a few thousand waveform samples to recontruct a waveform, there's no real point in using any more — all you achieve is slightly lower distortion. And considering that the output frequencies near the top end of the DDS's range will be produced using quite a small number of waveform samples per cycle anyway, there's little to be gained by making those at the bottom end of the range *vastly* more 'pure'.

So by 'truncating' the phase accumulator's output, and using only some of its bits for ROM addressing, it's possible to use a much smaller and more practical ROM — and the only real penalty is that the waveform for our lowest output frequencies will not be *quite* as pure as otherwise, before filtering. It will still be much cleaner than the higher frequencies, in any case.

As you can see, the Q2220 uses the 14 most significant phase accumulator bits to address the waveform ROM. This still corresponds to 16,384 waveform samples per output cycle, at the lowest output frequency...

By the way, the 'Sine Computation Function' in the Q2220 actually *isn't* a simple ROM containing sine waveform samples — although it performs essentially the same function. Although Qualcomm are a bit cagey about giving too much away, it's probably a small ROM containing samples for only *one quarter* of a sine waveform, with logic so that the samples can be scanned in both directions (i.e., forward and backward), and with automatic binary polarity control so that it can be used to generate the full waveform. This is a further 'trick' that is apparently pulled by DDS designers, to simplify chip design.

You've perhaps also noted that the digital waveform samples stored in the Q2220's 'Sine Computation Function' ROM are actually only 10 bits wide. How is it that we're now down to binary numbers only 10 bits wide — after starting at 24, and then pruning them first to 23 bits, and then down to 14?

The answer here is that until now, we've been talking about *address* bits, used ultimately to determine the *phase resolution* of the output waveform. In other words, the bits that determine its 'horizontal' resolution. But the output bits that finally emerge from the Q2220 are those which make up the actual digital waveform samples themselves — and which determine the *amplitude resolution* of the output waveform. Its 'vertical' resolution, if you like.

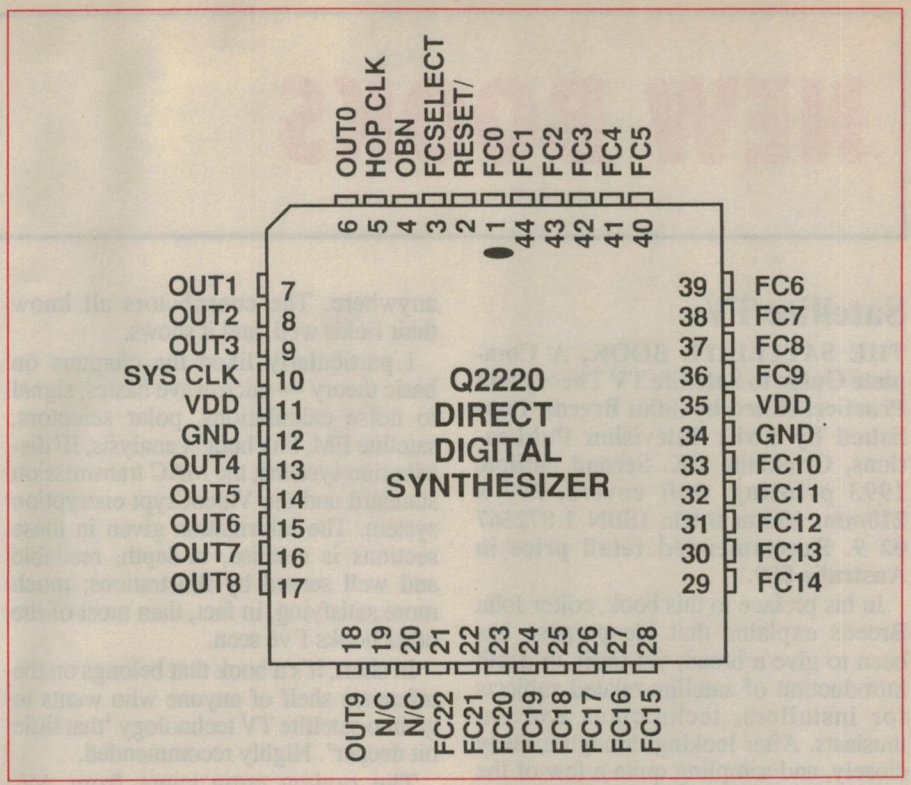


Fig.4: The pin connections for the Q2220, which comes in a 44-pin plastic leadless chip carrier (PLCC) package.

By providing binary output samples 10 bits wide, the Q2220 thus allows reconstruction of a waveform with up to 1024 different amplitude levels. This allows quite accurate waveform reconstruction, assuming of course that the output words are fed to a 10-bit DAC. (In the Novatech kit, an 8-bit DAC is used, as an economy measure; but this still provides 256 different amplitude levels.)

The Q2220 also provides an 'OBN' control input for the output section of the chip, as you can see. This is used to control whether the binary waveform samples are in 'offset binary' or 'two's complement' binary notation — corresponding to DAC output waveforms which are either varying between zero volts and a positive value, or bipolar with respect to zero volts.

Finally, the 'HOP CLK' and 'FC SELECT' inputs on the Q2220 are used to control the way that it feeds the Frequency Control input information into the phase accumulator. When FC SELECT is tied to logic 0, the data on the FC input lines is loaded into the chip's internal Frequency Control register automatically, during every system clock pulse cycle. However when FC select is tied to logic 1 instead, the FC input information is only loaded into the FC register in response to a 'strobe' pulse applied to the HOP CLK input. This gives two optional methods of changing the DDS's output frequency, from one setting to the next.

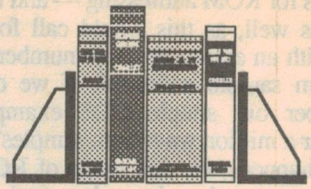
Fig.3 shows the way that the Q2220 is used to form a complete digital frequency synthesiser. The only other components needed to produce programmable-frequency sinewaves are a clock pulse generator, a DAC and a low-pass filter — plus circuitry to provide the Q2220 with 23-bit frequency control words, in binary.

Fig.4 shows the pin connections for the Q2220 device, which comes in a 44-pin PLCC (plastic leadless chip carrier) package.

The chip operates from a single +5V DC supply, and thanks to the use of low-power CMOS technology it dissipates less than 250mW, even when running at the maximum clock rate of 50MHz. It can be switched from one output frequency to another in a single clock cycle (i.e., 20ns), although there is a throughput delay of five clock cycles (100ns).

Further details on the Q2220 or any of Qualcomm Inc's other DDS products can be obtained from the firm's Australian distributor Veltek, at 18 Harker Street (PO Box 112), Burwood Vic 3125; phone (03) 808 7511. ❖

NEW BOOKS



Satellite TV

THE SATELLITE BOOK, A Complete Guide to Satellite TV Theory and Practice, edited by John Breeds. Published by Swift Television Publications, Cricklade UK. Second edition, 1993 printing. Soft covers, 297 x 210mm, 20mm thick. ISBN 1 872567 02 9. Recommended retail price in Australia $89.

In his preface to this book, editor John Breeds explains that his purpose has been to give a broad, yet fairly in-depth introduction of satellite-related subjects for installers, technicians and enthusiasts. After looking through it fairly closely, and sampling quite a few of the chapters, my impression is that he has achieved this aim extremely well. In fact he seems to have produced an excellent reference manual on just about every aspect of satellite TV reception technology — a veritable 'bible' on the subject, from the technical point of view.

As you might expect, it's written specifically for the reader in the UK and Europe. As a result some of the details given refer to European conditions, and the satellites covering that area of the world. However apart from this there's a great deal of practical material that applies just as much to our part of the world — plus a lot of really good basic theoretical stuff that is relevant anywhere. The contributors all know their fields well, and it shows.

I particularly liked the chapters on basic theory — microwave basics, signal to noise calculations, polar selectors, satellite FM, link budget analysis, IF distribution systems, the MAC transmission standard and the VideoCrypt encryption system. The information given in these sections is concise, in-depth, readable and well served by illustrations; much more satisfying, in fact, than most of the other books I've seen.

In short, it's a book that belongs on the reference shelf of anyone who wants to go into satellite TV technology 'that little bit deeper'. Highly recommended.

The review copy came from AV-COMM (PO Box 225, Balgowlah 2093), which is the exclusive distributor for Australia. However I understand Dick Smith Electronics stores will be stocking it, also. (J.R.)

UK radio pioneer

A FIRST CLASS JOB! The Story of Frank Murphy, Radio Pioneer, by Joan Long. Published by Joan Long, Sheringham, Norfolk UK, 1985; reprinted 1992. Soft covers, 210 x 148mm, 210 pages. ISBN 0 9511208 0 8. Price by mail £8.50, or US$15.

Murphy radio and TV receivers have been well regarded in the UK for many decades, and this is the story of the man who founded the company back in 1929. Frank Murphy was known throughout the country for many years as 'The Man with the Pipe', from the way he featured in many of the firm's early advertising and promotions; he also became famous as a pioneer in the area of industrial relations, being the first to campaign against seasonal unemployment in the radio industry. In the process he also built up a very successful company during the depression, mainly because of his insistence on quality sets that were priced low enough to be accessible to working people. He was quite an outstanding figure in the British electronics industry, in other words.

In this book, his daughter Joan Long (herself now a lady of mature years) tells the story of her father's eventful life, covering his founding and running of Murphy Radio right through to his departure and founding of a furniture company in 1938, and later his move to Canada where he died in 1955. It makes very interesting reading, for anyone seeking further insight into the early days of the radio manufacturing industry in Britain — and also an insight into a remarkable pioneer of that industry.

The review copy came directly from Mrs Long, who can supply the book directly for the prices quoted (Sterling or US currency). Her address is 5c Weybourne Road, Sheringham, Norfolk NR26 8HF, UK. (J.R.)

Useful information

ELECTRONICS ENGINEER'S REFERENCE BOOK, edited by F.F. Mazda. Published by Butterworth-Heinemann, 1989. Soft cover, 240 x 175 x 55mm. ISBN 0-7506-0809-9. Recommended retail price $140.00.

This huge reference book contains 63 chapters of useful material for engineers. For convenience, it has been grouped into five sections.

Part one contains a synopsis of mathematical and electrical techniques used in the analysis of electronic systems. Part two covers physical phenomena (electricity, light, etc.), while part three covers basic electronic components and materials. Part four deals with electronic circuit design and instrumentation, and part five looks at application areas such as radar and computers.

This sixth edition includes a revision of all earlier material, plus the addition of six new chapters on topics which are gaining in importance, e.g. ASICs like gate arrays, and digital system analysis covering areas such as LANs.

If you can afford the price, this tome brings together in one volume an enormous amount of technical information. Each topic is covered thoroughly, if concisely, with explanatory diagrams. An extremely thorough reference for anyone involved in electronics.

The review copy came from Butterworths, 271-273 Lane Cove Road, North Ryde 2113. It is available through technical bookshops. (P.M.) ❖

Electronics Australia Special Offer

Every new or renewed subscriber receives a free gift.

Subscribing to Australia's top selling Electronic magazine makes complete sense. Firstly, you receive the magazine early each month and keep up with the latest news on professional electronics and technical details. Secondly, you read about the interesting projects that we always offer and also have your say through our columns and comments.

As a special offer, for all new or renewed subscribers, Electronics Australia is giving away an eightpiece Hobby Tool Kit valued at $19.95, complete with six screwdriver, long nose pliers and side cutters. The pliers are hardened and tempered with insulated handles - An offer too good to refuse!

A subscription costs $47.00 including postage (over 30% saving off the cover price). Simply fill in the coupon supplied or phone toll free 008 800 933, and we'll start your subscription with the next available issue

HOW TO SUBSCRIBE: Simply phone our toll free number 008 800 933 and have your credit card details ready. If you do not have a credit card then fill out the coupon attached and post. If the coupon is missing, send your name, address, phone number and cheque to: Federal Publishing Company, Reply Paid No. 3, PO Box 199, Alexandria NSW 2015. Any enquiries can be made by phoning (02) 353 6666. Unsigned orders can not be accepted.

HURRY OFFER ENDS 26/5/93

THE SERVICEMAN

Don't people CARE that their TV set might catch fire?

This month I'm going to open the column with a few words on product safety, manufacturers' responsibilities and consumer reaction. As you will see, despite the companies' best efforts, many of the public seemingly couldn't care less. There's also a couple of 'nitty gritty' servicing stories, both about frustrating faults in video recorders.

A month or two back, there was a spate of 'Product Recall' notices in the daily press. Of particular interest to the electronic service industry were the recall of several popular model television sets by Samsung and AWA.

It was coincidental that the two companies issued recall notices within a week or two of each other. What was less coincidental was the reason for the recalls.

In the case of the Samsung sets, it was necessary to inspect solder joints around the horizontal linearity circuit. These joints are noted for a tendency to break down, and most of us have learned to resolder them as a matter of course.

In the worst of cases, these dry joints actually begin to burn the board and patching the holes has sometimes occupied more hours than the job was really worth. Much better to find the dry joints before they burn, hence the Samsung advertisement.

As with the Samsung product, the AWA sets also suffer from dry joints. However, the hazard created by these dry joints was aggravated, as the result of a decision taken by the Korean company who actually manufactured the sets for Mitsubishi Electric AWA.

It should be noted that very few domestic products are now made completely in their 'country of origin'. Although Mitsubishi Electric AWA is a Japanese company, a large part of their production is made off-shore, in places like Korea and Singapore. Other firms have other sources, such as Taiwan, Indonesia or China. The AWA sets that were the subject of this recall notice were of Korean origin.

One of the requirements specified by current product safety codes, and by Mitsubishi as a responsible manufacturer, is that all critical plastic components are to be of a flame-retardant material. This includes not only the cabinet, but also the numerous plastic components inside the cabinet. (When these sets were manufactured, some four or five years ago, they met all of the safety requirements in force at that time.)

Unfortunately, the Korean manufacturer used a *non* flame-retardant plastic material for the support frame that surrounds the printed circuit board. Even more unfortunately, the support frame comes very close to the section of the board where there is a strong possibility of dry joints occurring...

Even though the cabinet has been formed of the correct flame retardant material, if the support frame had ignited there would be a real risk of external damage and this was a risk that could not be tolerated. Hence the 'Recall Notice'.

In all, the Mitsubishi recall affects some 15,300 sets, of two different models. It seems that not all of these sets are at risk, however; some at least were fitted with a frame of the proper material. But, as it is not possible to specify which of the fifteen thousand sets are safe, the company is recalling the lot for examination and repair if necessary.

According to the rework instructions issued by Mitsubishi, the defective support frame is made of white plastic. The correct material is of black plastic. So any set with a white frame around the main PCB is suspect. The complete rework schedule requires the replacement of the white plastic frame with the approved black product, the removal of the plastic support bracket around the line output transformer, and the resoldering of 18 specified solder joints.

Because the company has a legal responsibility to complete this work to the best of its ability, they prefer to do the work in their own workshops. The recall notice states that owners should return the sets to Mitsubishi for examination. The company will provide packaging and will pay the freight wherever this is necessary.

Alternatively, approved service technicians will be able to do the job on Mitsubishi's behalf. In this case, the serviceman will be under an obligation to perform the work to Mitsubishi's exacting standards, and to return the defective parts to the company so that their records can be updated.

In recent years the distinctive 'Recall Notice' advertisement has become quite common in the daily press. The manufacturers of all kinds of products have responded to the legal requirement that they respect the consumer's right to protection from dangerous goods.

These recall notices have not often referred to domestic electronic products. Yet when you think of the countless televisions, video recorders, stereos, microwaves and other electronics in homes around the country, it comes as a surprise that so few recalls have been necessary.

As a result, the Samsung and Mitsubishi notices were highly visible and should have brought a strong response. On the contrary: at least so far as Mitsubishi is concerned, the result is just the opposite. At the time of writing, less than 8% of the fifteen thousand sets have been inspected.

Makes you wonder, doesn't it? Do people really read those recall notices?

For the record, the Samsung recall covered their 20" sets, model numbers CB515F and CB515Z. Owners of these models should phone 008 803 444 toll free.

The Mitsubishi Electric AWA recall covered their 14" sets, model C3420 from serial number 3420 0001 to 3420 8765, and model C3421 from serial number 3421 0001 to 3421 6570. The Mitsubishi toll-free phone number is 008 811 212.

One troublesome VCR...

Now back to more familiar ground. This time we have a story from L.G. of Robina, Queensland. It seems that L.G. has done battle with another of the same model VCR that was featured in the June 1992 column.

If you recall that story, it was about a video recorder with the most complicated power supply ever fitted into a domestic product. The circuit of the power supply alone took a whole page in this magazine! You might like to look up that diagram to help you follow this new story.

Well, L.G. is another of those intrepid adventurers who never hesitate to dive into this 'die-cast box'. For my part, I'm going to stay out. Here's how he tells the story:

I recently received into the workshop a Sharp video recorder, model VC387X. It came with the story that "...I bought it at an auction and it doesn't work. Fix it!"

I've seen a few of this model over the years. Fortunately, my experience had been confined to replacing belts, idlers and other miscellaneous mechanical parts. Now it appeared that I would have to delve into the electronics.

On removing the covers, I found that the capstan belt was missing — and thought that a good enough excuse for the machine not working. Then I spotted the power supply, a large and heavy diecast metal box. This reminded me that a friend had told me of some of the terrible times he had had when working on this model.

A few quick checks revealed that there was no output from the power supply, so I proceeded to remove it from the chassis. Extracting the screws proved to be the easy part. There were cables running to every circuit board in the VCR, and it seemed that you had to practically dismantle the whole machine to get the module out.

Eventually I succeeded in my endeavours and opened the box on the bench. The first thing I saw was a blown fuse, and although I checked as many components as I could, I found nothing to explain the fuse's demise. So I fitted a new fuse and switched on. The fuse remained intact, but a check of the various voltages marked on the board showed that the supply was not operating.

I began checking the supply right from the AC input, and found power as far as the main filter capacitor C912; so at least that part was operational. But I could find no voltages anywhere else. There is a control IC, U931 which had no voltages on it and I figured that it should be getting at least some, probably about 12V derived from Q904, T904 and Q903. I checked all the components around this area, but they all appeared to be OK.

Just for a laugh!

Trade newsletters are a prolific source of 'in' jokes, and that from Western Australia's division of TETIA is no exception. This one was printed with a perfectly straight face, but I'm sure the tongue was firmly in somebody's cheek:

A customer had returned a piece of electronic equipment to our shop twice, to have the same problem repaired. All diagnostic tests indicated that everything was operating correctly — a classic case of the 'Technician Syndrome', where the equipment won't malfunction while ever it's being watched by a technician.

As a joke, I placed a photo of myself on the inside cover of the chassis, directly over the microprocessor. That was seven years ago, and the equipment has worked flawlessly ever since...

I decided to check with the CRO to see what was happening and discovered that Q903 was switching, but it was giving a pulse of around 1us duration about every 500ms — which didn't seem to be right at all. I replaced C916, a 47uF electro, and this time I could hear the supply start to sing. So I figured that I was on the right track. I checked the output of Q904 and I now had about 2.5 volts, an improvement but still not correct.

A quick check with the CRO indicated that I was getting large pulses in the secondary of T904, but not much out of the regulator. I changed C919 and C920 and then had 12.2 volts out of Q904. A check of the outputs was disappointing, as I still had nothing there. Another check with the CRO indicated that I was getting nothing out of U931 to drive the main switching section — so could the IC be faulty? It was a possibility, but then I thought about all those faulty capacitors.

I decided to change C933 and C937 in the control circuit, and this proved to be the right thing to do. I then had about 6V on the 9V rail.

The output of the main supply feeds a number of other switched supplies, as well as feeding directly into a 9V regulator U901. The main output of 14 volts is filtered by C951, a 1000uF 16V electrolytic, and I measured 27 volts across this capacitor.

I had not switched the supply off at this time, and as I was considering the voltage measurements, a loud hissing noise and a great cloud of acrid smoke arose from the supply before my eyes. I lost no time in removing the power and when I lifted the supply, I found a large brown stain on the bench, right under where C951 had been. Everything else appeared to be in order so I replaced C951 and cautiously restored power.

This time I had 14.3 volts on C951 and 9 volts on the 9V rail. It now seemed that all the voltages were present and correct, so I re-assembled the supply and refitted it to the VCR. At switch-on, everything did exactly as it was supposed to do, so I proceeded to tune in the eight channels we have here on the Gold Coast.

After I had finished this, I noticed that the front panel display was blank. A quick check of the schematic diagram showed that the display should receive 7.5V AC and -24V from the power supply. Needless to say both rails were missing; so the supply had to be removed, again. This time I replaced C972, C974 and C976 and once more the missing voltages reappeared.

At this stage there were still about a dozen electrolytic capacitors in the supply that I had not changed, and for a while I was tempted to change them for good luck. However, I had spent a lot of time and quite a few dollars on the machine so far and so elected not to go any further at this time. The supply was once again reassembled and refitted to the chassis. At long last I was able to set about testing the mechanics of the machine.

As mentioned earlier, the capstan belt was missing so I fitted a new one, along with a new idler. The tape path was in a filthy state, so it was fully cleaned and lubricated as required.

By his time I felt confident enough to insert a tape and watch what happened. Everything worked OK; but as you may well have anticipated, the video heads were completely worn out and totally unserviceable. They would have to be replaced.

Fortunately, I had kept in touch with the customer and advised him of the various problems as they arose. He kept

saying "Fix it", although he did turn rather pale when told the final cost. The last I saw of him he was muttering something about auctions and auctioneers. I am sure that will be the last time he buys anything from that source.

As for my part, I cannot explain the blown fuse, except to suggest that it had something to do with all the dud capacitors. I hope that I don't see this particular machine, or others of the same model, for a long time to come.

Thanks for that story, L.G. I awarded a medal to the last contributor for his bravery in tackling this monster. I feel that you are equally deserving.

I may have been lucky, or it may be that none of those monsters were sold around my patch, because I have not seen one of these yet. Perhaps I've got a treat in store.

...and another

Now back to my own bailiwick, for a story that began by looking to be totally electronic, but finished up as an unusual kind of mechanical trouble.

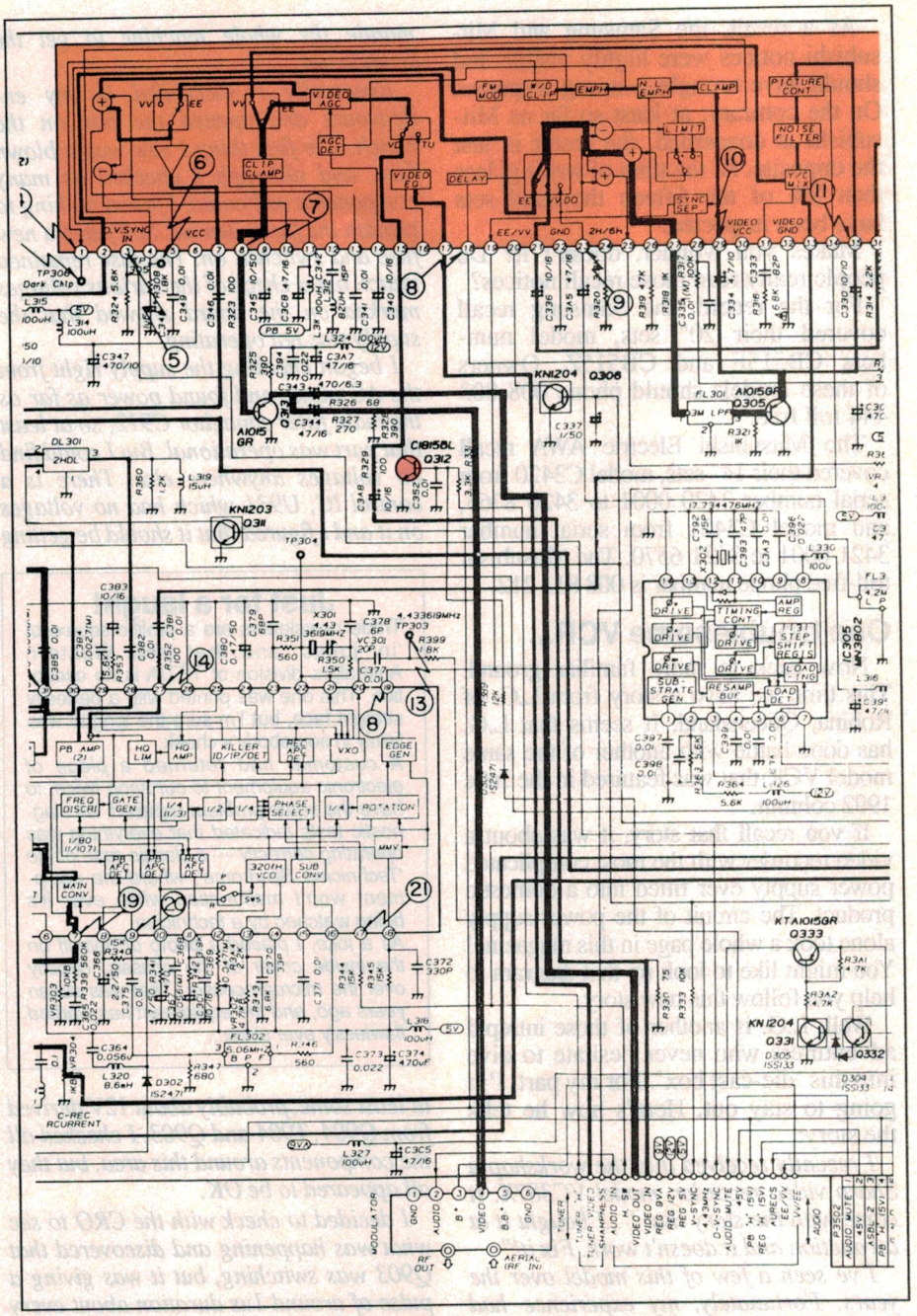
I was called in to look at a 'big' AWA console type television. The customer insisted that I call at their home, since the set was too large for them to get into their car. (I have never been able to understand why people buy sedan cars instead of station waggons. At some time or another everyone needs to move furniture or some other large object, and a sedan must be the most useless vehicle ever designed for the purpose!)

Anyway, on this occasion I was talked into visiting their home since the television would not reproduce any picture or sound from their video recorder.

I should have been alerted by that last statement, but for some reason I chose to ignore it. I imagined that it was simply their inability to tune the TV to the video — a not uncommon problem with the incredibly complex tuning systems fitted to so many modern TV's and videos.

When I arrived at their home, I found that the problem was not with the TV at all, but with the video recorder. The TV was not one of those modern monsters that I had expected, but was in fact a very early model AWA console, fitted with the notorious 4KA chassis. Quite surprisingly, the set was still presenting a near perfect picture, every bit as good as any I've ever seen on this model.

The VCR, an AWA model AV62, was properly tuned to the TV, and would replay a pre-recorded tape without any trouble. Movies they had taped last week were replayed perfectly. I tried retuning the VCR, on the suspicion that it had been mistuned by 'little fingers' — though when I suggested that grandchildren or the like had been visiting, I was told in no uncertain terms that "...their grandchildren were better behaved than that!"



Our Serviceman's own story this month concerns problems with an AWA model AV62, which had a problem with the 'EE' signal. Here's the relevant section of the circuit, with video switching chip IC302 at the top.

In any case, retuning the VCR did not restore either picture or sound. So it was not simply a problem of tuning. It looked like a problem with signal processing in the VCR. I fiddled around for 15 minutes or so, but couldn't get any sign of a response from the TV. So I reluctantly accepted the fact that I had been conned into doing a house call for a video.

I packed the offending machine into the waggon and toddled off back to the workshop. I had insisted that the customer was responsible for at least my 'house call' fee but I couldn't help feeling put upon, and I wondered how much cheaper the job would have been if the customer had done a few simple tests for himself before calling me!

Back at the ranch, I put the machine through a similar range of tests as I had performed at the customers home. All that did was to confirm that the VCR had no tuner function.

When a VCR is in the standby mode, it

should output a signal corresponding to whichever channel it is currently tuned to. In the parlance of the trade, this is the 'EE' mode. EE means 'Electronic to Electronic' and in professional TV fields refers to a testing system which checks every part of the system except the actual signal on tape. A professional EE converts the video signal to FM, ready for application to the tape then reconverts it back to video replay format, thus proving that every part of the system is working properly. In a domestic situation, EE refers to a much less exacting test, being nothing more than a signal passed directly from the RF input to the RF output. All this proves is that the VCR is properly tuned to a television channel.

I unbuttoned the cabinet and began a search for relevant voltages and signals. It didn't take long to find that all the tuner and IF supply voltages were correct and indeed, a signal tracer showed that there was even a good audio signal output from the IF strip. I fired up the CRO and soon proved that there was also a perfect video output from the IF strip.

I traced the video signal from the IF strip output to the input of the video processing chip IC302. Inside this chip it went to an electronic switch, which toggles between the video line input and the tuner. If I had been properly awake at this point, I would have solved the problem within a few minutes. As it was, I went on looking for other causes.

I was particularly concerned with IC302 and how it switched the video between line and tuner. It seemed to me that there had to be a voltage to toggle the switch, but I couldn't determine where such a voltage came from, or on which pin it was applied to do its job.

While I was studying the circuit diagram, I came across a line entering the Y/C circuitry that was labelled 'Tuner H'. It led to a transistor switch (Q312) which seemed to have no purpose but to short the 'line in' video signal to ground!

A branch off this Tuner H line went away to another part of the board where it was applied to VV/EE, an appellation that made little or no sense. Well, perhaps just a little sense, since I was seeking to restore the EE part of the label. But it still didn't show me how the switch in IC302 was toggled. Or where!

I turned to the overall wiring diagram provided in the manual, but it was little better than useless. The Y/C, Audio, Tuner and IF circuits are shown separately in the various circuit diagrams, but are lumped together in the wiring diagram. As a result, many of the interconnections are not shown on the latter drawing and it's extremely difficult to trace them from one circuit sheet to another.

In the event, this is what I had to do. A label on the edge of one diagram had to be traced to a similar label on the edge of another diagram, without any indication of which diagram it might be. As there are dozens of labels around each diagram, it really is the pits working your way through them. I was sure that this 'Tuner H' line held the solution to my problem, but finding it wasn't easy.

In the end, the overall wiring diagram provided the clue that led to the solution.

I found the elusive 'Tuner H' left the Y/C board on plug P7601, and went to the Timer board which carries all the user controls. The line enters on plug P6702 and goes straight to the Tuner/Line switch. Suddenly, I had that sinking kind of feeling one gets when one realises that one is a nerd. The aforesaid Tuner/Line switch was in the 'line' position and I had spent an hour or more trying to find a fault that wasn't there. Putting the switch in the 'Tuner' position should cure all the troubles...

Except that it didn't! Neither position of the switch made any difference to the performance of the machine. The video still disappeared at the input to IC302.

The switch is a double pole double-throw slide switch, although only one pole is concerned with switching the video. In the tuner position, it puts a regulated 5V on the 'Tuner H' line. In the line position, it shorts the 'Tuner H' line to ground. (The second pole is concerned with switching the front panel display.)

My next exercise was to check if the 'Tuner H' line actually went to 5V with the switch in the tuner position. It didn't. In fact, the line was permanently shorted to ground. There were any number of opportunities for a short on this line, but it was relatively easy to reduce the number of possibilities. I simply pulled plug P6702, which separated the Y/C board from the Timer board. The short remained on the latter. Since the switch was a mechanical device, always the first suspect in a case like this, I removed it from the board and gave it a thorough examination on the bench. I found the fault in 10 seconds flat.

It seems that at some time in the past the switch had suffered a knock, which had caused the frame to distort slightly. These switches consist of a row of terminals over which a saddle shaped contactor can be made to slide. The contactors fit into a slot in the operating knob and are pushed back and forth by the knob.

What happens when the frame distorts is that the contactors slip out of the slot in the knob, and thereafter stay permanently on the one set of terminals. The knob can move anywhere, but the contactors won't follow it. That is what had happened here. The switch had been pushed into the line position when it had been thumped, and there in the line position it stayed. I thought I had solved the problem when I put the switch into the correct position, but the contactors inside didn't move, so the problem was still there.

Fortunately, I was able to straighten up the switch frame and put everything back into its rightful place. After that, the machine came good and gave a perfect EE picture. It also recorded and replayed perfectly, so the job was done.

For all of that, I never did find out how the TU/VD switch in IC302 works. I can't see any connection between the 'Tuner H' line and the IC. According to my reading of the circuit diagram, the tuner video is present at all times on pin 17 of the IC. When the machine is switched to TV, 5 volts is applied to Q312 which shorts the line video, at pin 15, to ground.

Perhaps the secret is that the presence of a short on pin 15 causes the internal switch to toggle to the tuner position. No short and it automatically goes into the line mode, the position in which I found the machine. Unfortunately, I didn't think to try shorting pin 15 to ground. That might have proved the point. Anyway, that's all guesswork because the manual gave no help whatsoever.

After that, all that remained was to get my 'house call fee' from the owner, and to remind him that in future he could save his money and my time by personally bringing the recorder to my workshop.

That's all for this month. At the moment we are right out of contributor's items, so that leaves plenty of opportunities for you to have your story of electronic mayhem committed to the immortal page (ugh!).

Until next month, then... ❖

Fault of the Month

Sanyo CTP8604 CTV

SYMPTOM: Rapid and continuous vertical bouncing, with occasional rolling. No sign of any horizontal instability.

CURE: C203, a 4.7uF electro between the first and second sync amplifiers, was defective. The cap allowed the fast horizontal pulses to pass, but broke down during the slower vertical pulses.

This information is supplied by courtesy of the Tasmanian Branch of The Electronics Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

APOLOGY:

HEWLETT-PACKARD HP54600 SERIES Digitising Scopes/FFT — PRICING

Due to an inadvertent mistake in our production system, which was not detected until the issue was printed, incorrect prices for these products were shown in the advertisement published on page 115 of our March 1993 issue, on behalf of Hewlett-Packard Australia.

The correct prices are as shown in the advertisement on the outside back cover of our February 1993 issue, and also on page 115 of this issue. The four-channel version of the HP54600 is priced at $4,840, while the price for the two-channel version is $4,170. Until June 30, 1993, the HP 54657A or 54658A FFT Measurement/Storage module is also available for $625. These prices are exclusive of sales tax.

Electronics Australia and Federal Publishing Company apologise to both our readers and HP Australia, for any inconvenience caused by this mistake.

Intriguing discovery by a reader:

YOUR REMOTE CONTROL MAY HAVE 'HIDDEN' BUTTONS!

Have you ever wished that your infra-red remote control had an extra feature or two? Something as basic as an 'eject' or 'quick-timer' button can make a VCR's remote control a lot more useful. Well, the good news is that you may already have them. Lurking beneath the plastic cover of many remote controls are 'hidden' buttons, which the manufacturers decided not to include in their final production models...

by DARRYL BARTLETT

These 'hidden' buttons are physically and electrically complete, and they work as well as any other button. The only difference is that they are shorter than the other buttons and don't protrude through the front of the case.

If you open your remote control, you'll probably find a single circuit board overlaid with a contoured rubber sheet which forms all the buttons. Quite often, there are some stumpy buttons on this rubber sheet which don't have a corresponding hole in the top cover. If you look at the circuit board, you'll also find conductive pads which align with them.

These extra buttons are the victims of ergonomics, style and product differentiation. Since the integrated circuits (ICs) used in the remote control usually have the potential to scan a large number of buttons (usually an even number like 56 or 64), it makes sense for the designers to include as many features as possible in the prototypes.

But as the product progresses through the design process, some of these buttons are lost due to decisions based on the perceived current market. The actual reasons are obviously very diverse, but the 'look and feel' of the remote control is a factor high on the list. If the manufacturer feels that users are looking for small, neat looking remote controls with only the basic functions, they may decide to remove all but the most basic features.

Another important reason for not including some buttons is to give added differentiation between models. For example, the manufacturer might remove a remote control feature from a two- head video cassette recorder (VCR) and leave it on an up-market four-head model. This makes the dearer model more attractive.

New functions

Exactly what hidden features, if any, your remote control has depends on the manufacturer and model. A large number of VCR remotes have extra buttons that provide useful features. Those for other equipment (televisions, CD players and the like) usually have some hidden buttons, but often they don't do anything.

If your remote control has a lot of blank space between some of the buttons, you're more likely to find extra buttons than on a crowded unit with little spare room.

As an example, the Sharp VC-101X VCR has a small remote control with only 11 buttons. But the circuit diagram for this model (Fig.1) shows that the IC in this unit can handle up to 56 different buttons, because of the '8 x 7' scanning matrix.

Lifting the lid on this remote control reveals five extra buttons. Although one button does nothing, the others offer some very useful functions.

There is a tape eject button, two quick timer buttons (for program-start and program-length), and a curious auto-loop button which provides a feature not originally found on the VCR. Pressing this last one when playing a tape sets the start position of the loop, pressing it again sets the end position. The VCR will then repeatedly play that section of the tape until the stop button is pressed.

On the remote for the Akai VS-425EA VCR, there are four extra buttons, although only one works. This unit is a little different to most models in that the buttons have actually been cut out of the rubber sheet. This makes it harder to modify, but not impossible. You'll need to find a button (preferably a hidden button that does nothing) from another remote control to stick into this one. Just cut the new button out, leaving a small lip of rubber around it, then cut the rubber sheet in the remote control so that the button will fit neatly into it. A small dab of glue should hold it securely.

This might sound like a lot of work for only one extra feature, but it's worth it. This new button adds 'blank-search' to your VCR — a feature only found on more up-market models. Pressing this button causes the VCR to fast forward to the next blank gap on the tape, and then stop.

A few typical remote controls. Those most likely to have 'hidden' buttons are generally the ones with a reasonable number of blank spaces between the obvious buttons.

This is useful for finding the end of a recorded section, in preparation to record something else after it.

The Canon E-60 video camera has an interesting button hidden inside its remote control. There are actually two buttons, but only one works. Each time you press the button, it brings up a different screen of text on the TV or monitor. There are four screens in total, headed 'SERVICE 1' through to 'SERVICE 4'. These screens provide tables of information about the camera which could be useful when servicing it.

Unfortunately, the text is very abbreviated and I could not decode what most of the tables referred to. I did manage to accidently change the low battery cut-off voltage (B ADJ) and got quite a shock when the camera started shutting down even when running off the 240 volt adaptor. Luckily, it reset itself to the right value after I left it unplugged for a while.

Of course, some remote controls don't provide any extra features at all. The Akai VS-765EA has a complex remote control, with more buttons on it than the VCR itself. Although there are six hidden buttons inside this unit, none of them actually does anything. The remote control does send a signal for four of the keys, but the VCR is apparently not programmed to respond to these signals.

If you own a Pioneer PD-M500 CD player, don't even bother opening its remote control. It does contain two hidden buttons, but they are incomplete since these buttons have no pads on the circuit board which correspond with them.

Modifying a remote

Opening a remote control can be as simple as removing a few screws and slipping the back off, or as complicated as searching for and releasing a number of internal plastic clips, in unknown locations.

The first step is to inspect the back cover and remove all the screws that are visible. Remember to check inside the battery compartment, because there is often one screw hidden in there.

If the back doesn't slip off easily, check for any small slots around the edge that might indicate a clip. If you find any, slip a small screwdriver in and try to gently release them.

There may be hidden clips around the edge also. The best way to release these is to carefully probe the edges with a fine screwdriver to find where the case is secured, then try to lever the case at that point. It is usually easier to release one of the shorter sides first, then work down the longer edges. If there is a battery compartment along one of the short sides, try starting there. The shape of the compartment should allow the plastic to be flexed easier.

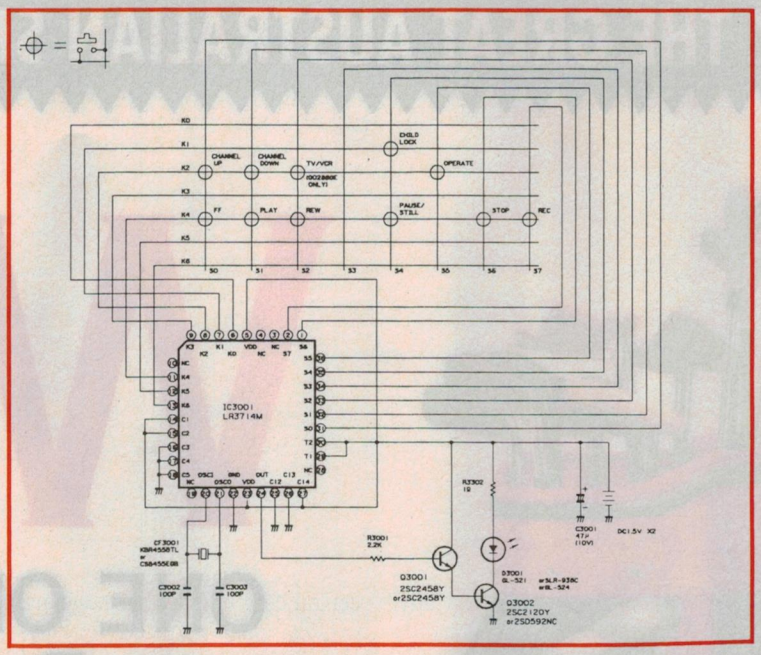


Fig.1: The schematic for a Sharp VC-A101X remote control, showing how the buttons are connected at the row and column intersections of a scanning matrix. This gives the potential for up to 56 possible buttons, in theory.

Once the case is apart, you may have to remove more screws before the circuit board and rubber sheet will come out. If there are any hidden buttons in your remote control, they should be obvious when you look at the rubber sheet. Look for stubby buttons that don't protrude through holes in the front cover. Also check for a corresponding pad pattern on the circuit board.

The next step is to discover what those extra buttons actually do. The easiest way to do this is to sit the circuit board in the bottom half of the case, put the batteries back in, and sit the rubber sheet over the circuit board so that the buttons align with their respective pads. With some models, this isn't as easy as it sounds and you may need to experiment a bit to find a convenient arrangement.

Now, try the new buttons out and carefully watch what happens. Depending on what you are using (television, VCR, CD player, or whatever) you will need to experiment with the equipment in its various modes. For instance, an eject button will only work if you already have a tape in your VCR, and 'auto-loop' only works in play mode.

Now that you know which buttons actually do something useful, it's time to make them into real buttons. There are an unlimited number of ways to do this, but they all basically rely on just sticking something on top of the button to make it a bit taller; then you fashion a suitable hole in the top cover.

Light Emitting Diodes (LEDs) of the larger type, with their legs cut off, make attractive buttons and only need a simple round hole in the case to stick through. You can use different colours for different types of functions if you like, or use dark coloured infra-red LEDs to get unobtrusive black buttons. You may have to cut or file some of the plastic from the back of the LED to make it the same height as the existing buttons.

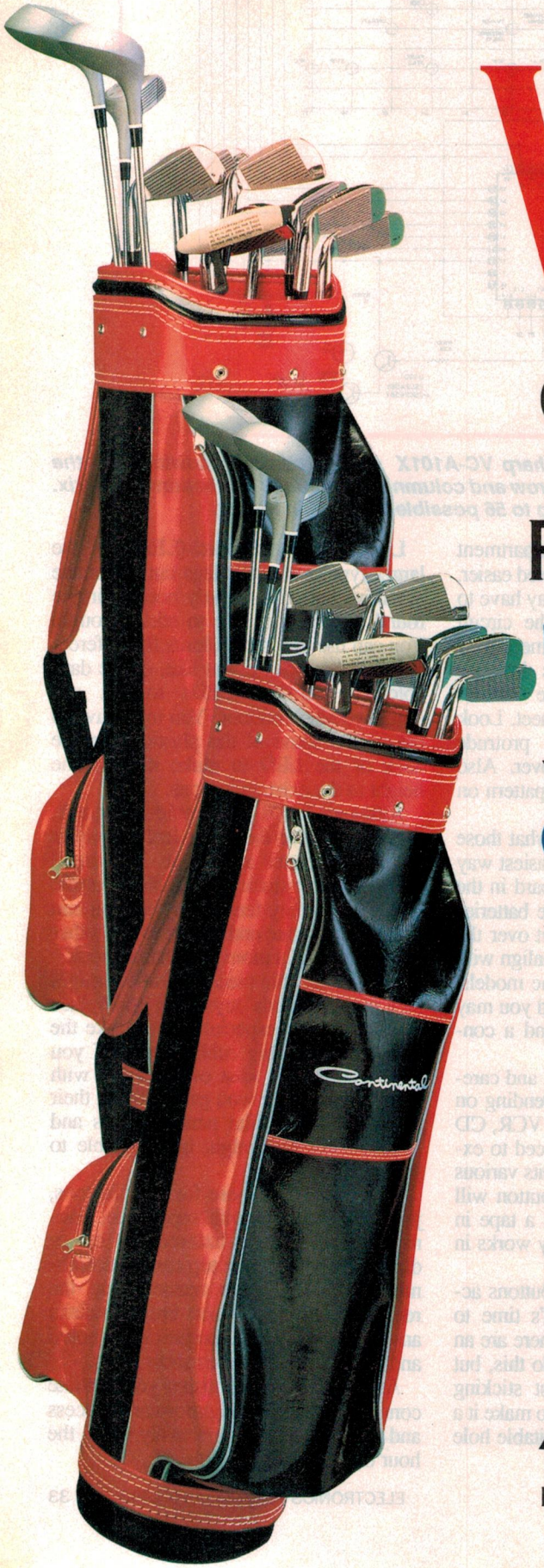
Although LEDs are simple and quick, they don't have the same feel as rubber buttons. A better alternative is a small piece of rubber stuck onto the short button. Not only do they feel better, but you can match the colour and shape to the other buttons and get a more professional look.

Finding suitable pieces of rubber might be a problem. Kids' toys are a good place to start looking, especially things like the spiky tread off big rubber tyres. If you don't cherish the idea of wrestling with your children over who gets to break their toys first, things like pencil erasers and small rubber feet might be adaptable to your purposes.

Whatever you choose for your buttons, just stick them on with super glue, five-minute Araldite or whatever, and cut or drill some holes in the top case to accommodate them. Before reassembling the remote control, use a soft brush to clean any dust from the pads on the circuit board and from the back of the rubber sheet.

And that's it. Customising your remote control is a fairly straightforward process and the extra features are easily worth the hour or so spent on the job. ❖

PLAY THE GREAT AUSTRALIAN SPORTS TRIVIA QUIZ



WIN

ONE OF TWO SETS OF PRO MASTER PLUS GOLF CLUBS.

PLUS 60 RUNNERS UP WILL WIN WINNING EDGE GOLF CALCULATORS.

CALL 00555 1058

and race the clock to answer five Aussie sports brain teasers.

Call as many times as you like. There will be new questions each time you call.

THE WINNERS will be the entrants who answer their trivia questions the fastest.

A TIE BREAKER question will be used in case of more than two winning times.

TOM WEISKOPF PRO MASTER PLUS irons are precision cast, triple chrome plated and offer total perimeter weighting for an enlarged sweet spot and greater accuracy. Both woods and irons offer improved alignment systems with yardage indicators on irons to ensure proper club selection. They come with True Temper dynamic gold shaft and top quality all weather corded grips. There is also a first grade golf bag to complete the set. Pro Master Plus clubs are distributed in Australia by Eclipse Golf of Heidelberg Victoria.

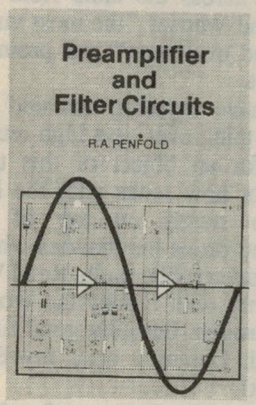
In case of a tie breaker the judges' decision will be final.

InPho 25¢ per 21.4 sec Premium.

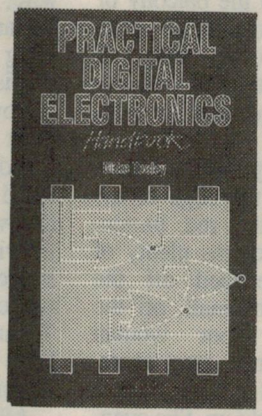
HURRY OFFER ENDS 1ST JUNE 1993.

Electronics Australia

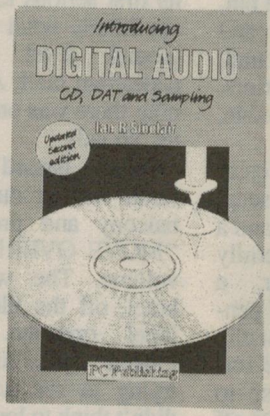
BOOKSHOP



Preamplifier and Filter Circuits
This book provides circuits and background information for a range of preamplifiers, plus time controls, filters and mixers. The circuits described are simple and previous experience of electronic project construction is not needed.
CODE: BP 3090 PRICE: $11.00

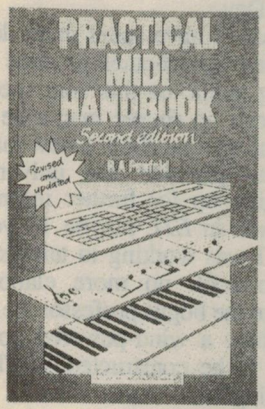


Practical Digitial Electronics Handbook
This book introduces digital circuits, logic gates, bistables and timers as well as microprocessers, memory and input/output devices. It will prove invaluable to anyone involved with the design, manufacture or servicing of digital circuitry.
CODE: PC 1004 PRICE: $22.95

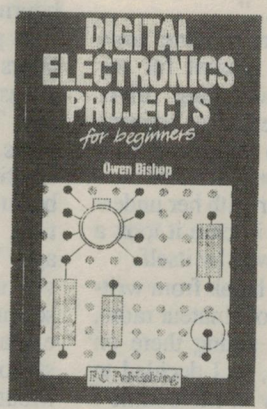


Introducing Digital Audio, CD, Dat and Sampling. - Second Edition:
This book bridges the gap for the technician and enthusiasts who have worked with audio circuits. It includes oversampling methods and bitstream techniques and technical terms.
CODE: PC 1007 PRICE: $22.95

Computers and Music - An Introduction:
This book explains how to simply set up your own computer music studio. It covers the basics of computing, running applications programs, wiring up a MIDI system plus everything about hardware and the programs.
CODE: PC 1006 PRICE: $27.95



Practical MIDI Handbook
Refers to the powerful capabilities of MIDI and how to exploit it, with no knowledge of electronics or computing. It reviews the latest developments in MIDI covering keyboards, drum machines, sequences, mixers, guitars etc.
CODE: PC 1002 PRICE: $22.95



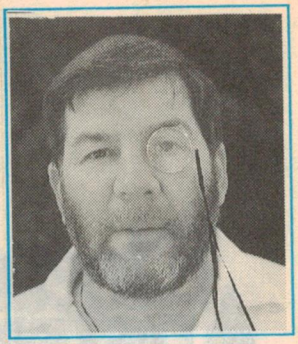
Digital Electronic Projects for beginners
This book provides simple, yet detailed instruction on practical projects. Covering instrumentation to home security plus circuit diagrams, this reference book also offers 'fun' projects for newcomers to electronic construction.
CODE: PC 1011 PRICE: $19.95

HOW TO ORDER

To order, simply fill in the coupon, remembering to include the code numbers and $5.00 postage and handling. If the coupon is missing, write down the names, code numbers and prices of the books you require. Include your name, address, phone number, plus cheque, money order or credit card details (card type, card number, expiry date and signature) and send it all to Federal Publishing, Reply Paid No. 3, PO Box 199, Alexandria, NSW 2015. Please allow at least 28 days for delivery and please sign all orders.

Moffat's Madhouse...

by TOM MOFFAT



For the Love of April...

"WATCH WHERE YOU'RE GOING, MORON!"

What? Who said that! Here I was standing in the checkout queue in a discount shop in Sydney. Everyone whipped around to stare at a girl standing in front of a bin of cheap electronic gadgets. "It wasn't me, really..." she whimpered, as she went a bright shade of red. "I only pressed a button..."

As the girl shuffled away from the bin, I broke from the checkout queue and shuffled towards it. What had she found, in this pit of contempt? Road Warriors, that's what, lying there in a jumble, seething with scorn.

Imagine a small black plastic case, about the size and shape of a bar of soap. On the front, four coloured buttons, and a grille for a speaker. Inside, a carefully programmed speech synthesizer, a powerful amplifier, and a couple of penlight cells. On the back, a convenient clip for belt or shirt pocket. And on the forward edge — the business end so to speak — is a LED that pulses on and off with the speech, like a red laser cannon blasting a stream of vitriol.

Road Warrior can be your faithful companion during those stressful times on the freeways, issuing invective with the Bronx-accented rage of a New York taxi driver. Press the green button and Road Warrior bellows "WATCH WHERE YOU'RE GOING, MORON!" The red button produces "MOVE OVER!"; the blue button yells "ROAD HOG!" and yellow produces "YOU SON OF A (beep)". It really means "You son of a bitch", but that term is considered very offensive in America, the market for which Road Warrior is primarily intended.

This amazing little device was on sale for $3.95, which was less than the cost of the batteries needed to power it. For under four dollars, you get a complete speech synthesizer, audio amplifier, and speaker. Definitely my kind of thing; I HAD to have one.

The blurb that comes with Road Warrior says it is for 'fun only'. Now it couldn't really be used for serious purposes, like abusing the car in front of you. Two AAA penlight cells just don't provide enough poop to make the thing heard over road noise. Of course, if you hooked the Road Warrior to one of those CB radios that has a PA speaker behind the car's front grille — no, forget I said that.

However, in a quiet location, Road Warrior more than holds its own. I gave it its first serious test from the balcony of our Manly hotel room, one floor above ground level and overlooking a pedestrian mall. At that time of the evening there was only one pedestrian, a little old lady.

As she passed directly below, I held Road Warrior out over the edge of the balcony and pressed the red button. "MOVE OVER!" There was plenty of volume. The words echoed off the hotel, off the tiles of the mall, off the hotel opposite. The poor woman looked here, there, and everywhere, trying to see who had bellowed. She didn't think to look straight up. She eventually shrugged her shoulders and moved on. I gave her a parting "ROAD HOG!" just for good measure.

Ah, such fun. The next day, strolling along the Corso at Manly, Road Warrior hidden in the palm of the hand, merrily pressing the buttons. "WATCH WHERE YOU'RE GOING, MORON!... ROAD HOG!... MOVE OVER!..."

I brought Road Warrior home from Sydney primarily as a present for my daughter, who was undergoing driver training. I gave it to her as a 'training aid', but she wasn't too impressed with my little joke. The Road Warrior was soon buried in the drawer with her underwear, batteries removed in case it took a notion to begin raging away by itself.

This morning I took a break from writing this column for a bit of amateur radio. The Road Warrior was sitting there on the table in front of me, so I decided to show it off to the fellow in Melbourne I was talking to. I held it up near the microphone and hit a button.

"MOVE OVER!"

There was a short silence from the other end, and then the fellow said "Some loud-mouth just broke in and told us to move over".

He didn't get it! Didn't know it was me! Ah, more possibilities, blasting your way through the ham bands...

But that's definitely NOT on; I'd probably do my licence for unidentified transmissions or something. Anyhow the temptation is no longer there. My wife, sitting across the table from me, declared Road Warrior "the most vulgar thing she had ever seen" and promptly confiscated it.

Now, to have anything declared 'the most vulgar thing ever' is a high recommendation for an object of this type. Road Warrior now ranks with the little fellow who stands on top of our television and drops his drawers when I squeeze a hidden rubber bulb. Road Warrior even ranks with Flubby the Wonder Technician; rough, but jolly good fun to have around. Damn! I want my Road Warrior back!

All right, no letters of abuse, thanks. I know it's childish. But it demonstrates a streak in my personality that raises its ugly head every year at this time. You see, it's April. And the very first day of this month is when fools like me run rampant across the land, causing as much havoc as possible. April First is better than Christmas, or even Melbourne Cup Day.

In past years I have spent many long hours working up schemes to dupe the unsuspecting public on this very special day. These can be simple magazine articles, such as the one about a new mathematical principle that had university boffins ringing up for further information. That was in *ETI*, maybe 10 years ago. When I was working in television, we used to cook up more elaborate schemes, like the bogus professor we had explaining how a wind-powered power station was to be constructed WITHIN Mount Wellington.

This year, with *Electronics Australia* usually coming out a bit before the official publication date, maybe you'll get to read this just before the magic April 1

date. So now we reflect on past glories, in hopes of inspiring you to take part in this pagan ritual in a few days' time. But don't copy these ideas; be original...

Road Warrior came along a little early for April Fools' Day, but mine has only been used in Sydney so far. The unsuspecting people of Hobart may still feel its sting, about the time you are reading this. Assuming, of course, I can get it back from my wife. An earlier scheme was a little more difficult to implement, but it brought much more profound results.

I was working in an electronics lab in the centre of Hobart, developing all kinds of robotics gadgets. Among our useful-bits collection was a little radio-controlled car we were planning to modify for computer control. Prior to modification, the car could whiz forward or whiz backward at the touch of a button. That's about all it did, but it was enough.

It was the practice back then for businesses to put their rubbish out on the footpath on Thursday afternoons for collection that night. On this particular Thursday, April 1, the bags and boxes of rubbish outside our business were joined by another large but fairly empty paper bag, containing only the radio controlled car. We had a window above the street, much like the hotel balcony in Manly, where we could keep an eye on the street below.

Pedestrians walking along Liverpool Street were accustomed to stepping aside to dodge the piles of rubbish on Thursday afternoons. But they weren't ready for the garbage bag that jumped out at them. As someone would walk by, we would hit the GO button on the car's controller. The car would scream along the full length of the paper bag, and when it hit the end its inertia would cause the whole bag to lurch out of the pile and chase the pedestrian...

When the paper bag came charging out of the rubbish pile, most people would do a little skip and a jump and try to outrun it. This was easy, because the bag couldn't go far once the car was jammed into the end. We could make it lurch again by reversing the car and then hitting the end a second time, but it would rock to a stop once more.

The most interesting pedestrians to watch were those who refused to believe their eyes. They would jump, and then look away as if nothing at all had happened. It was always worth producing a second lurch for these people. They would hear the whiz of the car and the rattle of the bag, and they'd only steal a second glance if they were sure nobody else was watching.

The car's demise came with the arrival of a big black dog. He positively swaggered along the footpath, unescorted by any human. This was his territory. And when he came up to our rubbish pile the dog decided it was time for a toilet break. He lifted his leg and took careful aim, right at the paper bag. And just as he let fly, we let fly, with the GO button. That was one surprised dog, standing there on three legs as his intended target charged at him from below.

After a burst of three-legged hopping the dog regained his composure and took direct, and very macho action. He tore into the bag with jaws and paws, ripping it to shreds. The little car was next, and before long it had gone to radio-control heaven. That joke was somewhat costly, but worth it.

Speaking of cars and dogs, consider the case of the controllable backfire. Back in my Melbourne days I knew a fellow who had an elderly Holden ute. This car developed some kind of ignition problem, so that it backfired with regularity. He soon learned that the little pop from the exhaust pipe could be turned into a shotgun blast if you turned off the key as the car rolled along, letting some unburnt fuel and air build up in the exhaust system. When you turned the key back on, BLAM!

During idle moments we would cruise around the streets of Richmond, exercising the car's tailpipe. The streets were hard bitumen, fronted by hard-surfaced buildings, so any BLAMs echoed around and were magnified in strength. Some parts of Richmond were a little rough, and the sound of a shotgun blast sent the residents running for cover. Nobody knew where it came from.

One afternoon this Holden ute happened upon the perfect target: a fellow out exercising three greyhound dogs on three individual leads, all at once. Aha! Key off. The ute coasted along, building up a massive charge of fuel. When it was dead abeam of the greyhounds, key on!

BLAAMMM!!! That ute fairly shook with the violence of the explosion that issued forth. And the greyhounds thought it was the starting gun. But instead of all running forward in the direction they were heading, each of the dogs bolted away from the others in a starburst formation. This left the owner holding three leather leads, each pulling at an angle of 120° from the others.

Having the choice of being hung, drawn, and quartered by the leather straps, or letting go, the owner let go. The result was like those diagrams you see of atoms splitting — the dogs shot away like neutrons, bombarding other pedestrians into a chain reaction of fury.

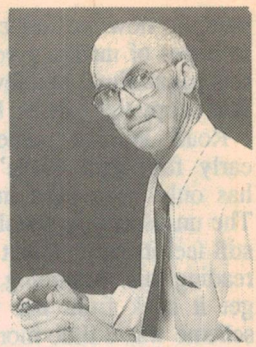
We got away from there too, quick. The car's little ignition problem was repaired soon after that.

There's lots of good harmless fun to be had in this serious old world. And this is certainly the season for it. I haven't actually written a proper April Fools' story for this year, thinking perhaps this column will do. But there's still plenty of time, as I write this, before the April deadline. Irresistible inspiration may yet strike.

So keep in mind that anything else written by me in this issue may well be a load of old codswallop. And I'm not the only one who writes this kind of stuff. Anything you read, anywhere this month, could be suspect. So remember, don't trust anyone... ❖

FORUM

Conducted by Jim Rowe



Dangers from ELF fields, more on compact fluoros and a critic of 'back-EMF'

Further to our discussions a few months back about the possible health risks associated with electromagnetic fields, I've found an interesting item about a proposed research project here in Australia. There's also a couple of reader letters, one about compact fluorescent lamps and the other complaining about he says is widespread misuse of the term 'back-EMF'.

Back in March last year, you may recall, we published a letter from 'G.S.', a reader in Albury NSW, enquiring about the possible increased risk of developing a brain tumour due to the electromagnetic field from a clock radio near your pillow. This stirred up a fair amount of comment — largely pooh-poohing the possibility of a risk, which I presented in the June issue. Then the more general topic of a possible health risk due to 'ELF' (extra-low frequency) fields was stirred up in the July issue, when we published Peter Vogel's 'Gaussbuster' project — a low cost gadget which works a bit like a Geiger counter, to indicate the presence of significant fields.

It was interesting that soon after we had published the Gaussbuster article, a long letter arrived from a Dr Trevor Boal of the Radiation Safety Section of Victoria's Health Department. In the letter (which we published in the November issue's Letters to the Editor column), Dr Boal basically 'jumped on' Peter Vogel for claiming in his article that the Victorian Health Commission believed there was a risk from fields as low as 3mG (milliGauss). Not so, said Dr Boal: the Victorian Health Department supports the National Health and Medical Research Council, which has endorsed the International Radiation Protection Agency's guidelines. These seem to specify 1000mG as the maximum safe exposure level over a 24-hour period...

In short, then, the whole subject of a possible health risk from low level electromagnetic fields seems to be a rather touchy one. There's a certain amount of empirical evidence suggesting that there *may* be a risk, even at field intensities rather lower than current officially accepted levels, while other research studies seem to have been inconclusive. As a result the various energy and health authorities are rather 'sensitive' to any perceived criticism (even defensive), and elsewhere there's a wide range of attitudes ranging from skepticism to serious concern.

In this context, I was interested to read some information on the topic which appeared in the latest annual report of the Australian Electricity Supply Industry Research Board (which is affiliated with the Electricity Supply Association of Australia). Because I think *EA* readers will find it interesting too, I'm going to reprint some of it here.

The first item of interest is a short quote attributed to Sir Harry Gibbs, in the *Report of Inquiry into Community Needs and High Voltage Transmission Line Development*, presented in February 1991:

It has not been established that electric fields or magnetic fields of power frequency are harmful to human health... However it has not been scientifically established that such fields are not harmful.

Which sums up the situation rather well, I think you'll agree. This degree of calm objectivity is perhaps not surprising coming from an experienced judge; it just seems a pity that not too many other people seem to be able to display it.

Moving on, though, the AESIRB article takes up the topic as follows:

Scientific study after scientific study has failed to yield definite conclusions about the impact of electric or magnetic fields (EMFs) on human health. The continuing uncertainty has fed, rather than allayed, the fears of those who believe EMFs are, or may be, a cause of such illnesses as leukemia and brain tumours.

Uncertainty is equally unhelpful and unwelcome to the electricity supply industry. It is compelled to plan for the provision of ever-increasing amounts of electric power, a basic need for a technologically advanced society, while having to endure the loudly-voiced suspicion and condemnation of a minority convinced that EMFs are harmful.

In quest of an answer, Dr Michael Repacholi, Chief Scientist at Royal Adelaide Hospital, proposes to conduct a large-scale experiment that may at last cast further light on the matter.

In essence, he wants to take 10 groups of mice, each group containing 100 animals, and expose them to strong EMFs for almost the whole of their natural lives, some two years, to see whether the result of the exposure is a higher incidence of cancer than would normally occur in groups of that size.

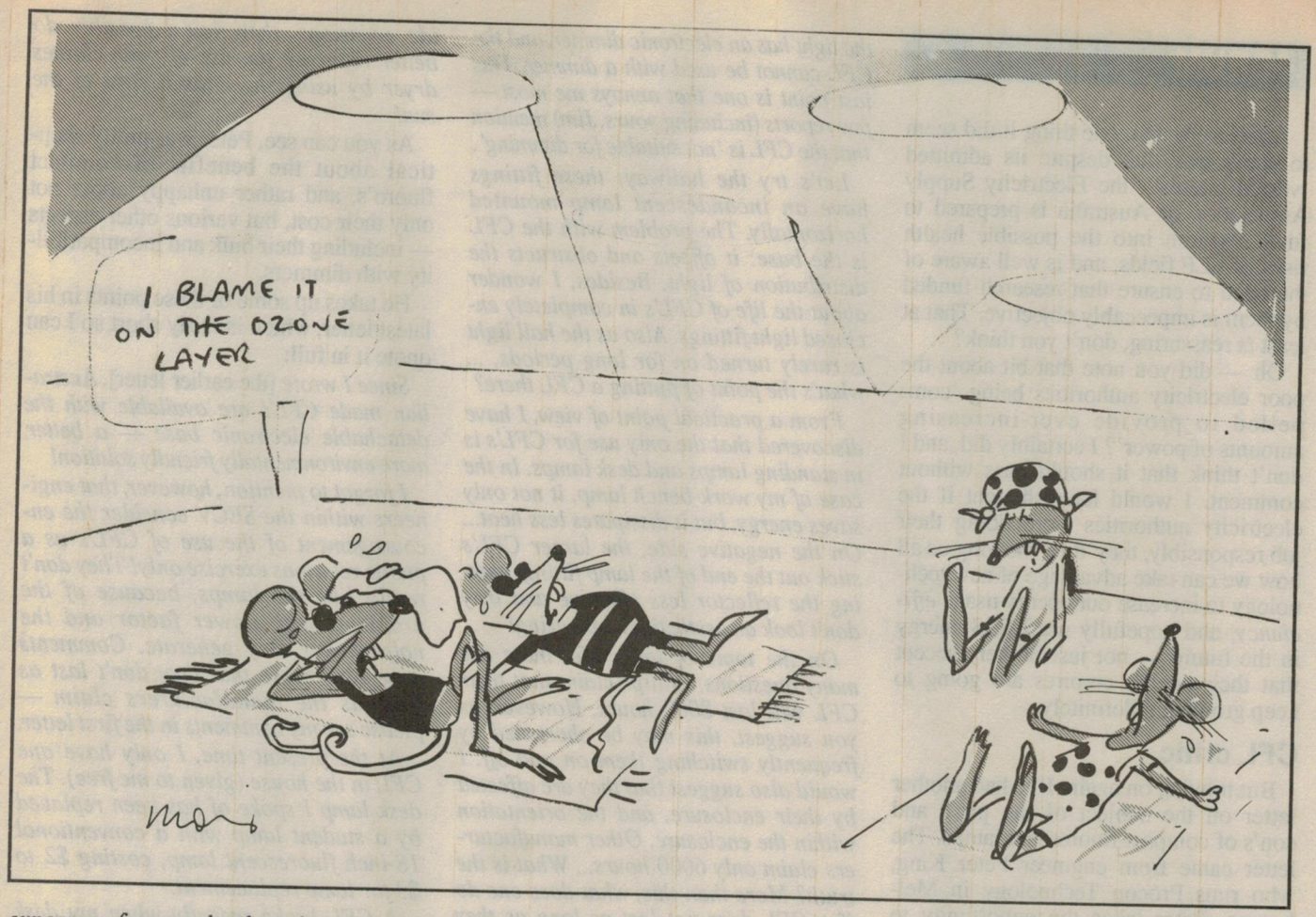
The mice to be selected are transgenic: they are genetically engineered with extra 'oncogenes' (cancer genes) that predispose them to getting T-cell lymphoma. About 15% of such animals would normally contract lymphoma during their lives. It is the purpose of the study to determine whether exposure to 50Hz magnetic fields will increase the incidence of lymphoma in this particularly sensitive strain of mice.

All 1000 mice would be 'initiated' by injection with a chemical likely to cause leukemia or brain tumours. The ten groups would then receive different treatment.

Three groups of mice would be the controls, not exposed to EMFs at all.

Another would go through the routine *of being exposed, without actually receiving any electro-magnetic energy other than the normal background that exists everywhere on earth. (This would test whether the procedure itself somehow — perhaps through stress — promoted cancer.)*

Six other groups would be constantly exposed to 50-hertz EMFs, at three different intensities. This would simulate



exposure, for nearly the whole of the mice's life-times, to the fields found near the highest-voltage power transmission lines currently in use.

At the conclusion of the study, the results would be analysed to determine whether the exposure of the mice to EMFs had aggravated or 'promoted' the frequency and severity of cancers and whether, in that case, any correlation could be found between the intensity of the field and the incidence and severity of cancer.

Dr Repacholi has asked the ESAA to support this ambitious and potentially important project financially.

However as Michael Dolan, Manager of ESAA's EMF Advisory Group has pointed out: "With the EMF health issue, the electricity supply industry is correctly perceived as having a vested interest in the outcome." One of the basic conditions of such a trial, thus, would have to be its supervision by a body that was demonstrably competent and incontestably objective.

Dr Repacholi has suggested the formation of an independent international 'panel of experts' to monitor the trial and evaluate the results. He believes an animal study of this nature would be a significant Australian contribution and complement to Australian and international epidemiological studies. These are statistical studies examining the incidence of disease in human populations. Their purpose is to see if there is any statistical association (not causation) between exposure to EMFs and disease. There are several such studies being conducted both overseas and in Australia. However AESIRB and its advisors have said they believe the Australian National Health and Medical Research Council (NHMRC) should have control of the project, to guarantee the scientific quality and independence of the proposed study.

The Executive Committee of the NHMRC has agreed to the establishment of a four-member working party, named the NHMRC Working Party on Possible ELF Electric and Magnetic Field Health Effects. The chairman is Dr Keith Lokan, a physicist who is director of the Australian Radiation Laboratory in Melbourne.

The NHMRC working party will coexist with an international scientific review panel set up by Dr Repacholi. The international panel will probably have an advisory role.

A preliminary study, funded by AESIRB and costing $50,000, has recently been completed. Its objectives were to assess the value and practicability of the proposed 'life time' trial and to determine, if it is decided the trial should proceed, what form it should take.

If the result of the preliminary assessment is favourable, ESAA has already decided that it will provide special funds for the project, funds that will not be taken from AESIRB's regular funding budget. The overall cost of the completed trials is expected to be $1.5 million.

Well, there you are — that's probably enough to give you a fair idea of what the proposed study is all about. I don't know about you, but I found it interesting not only because of its news that this research is likely to be carried out in Australia, but because of the insight it gives into the somewhat tortuous procedures which have to be followed before this kind of research can get going — largely because of the costs involved, I guess.

All the same, it does get a little confusing, doesn't it — ESAA's and AESIRB's and NHMRC's, advisory groups and working parties and review panels. It looks as if those poor mice are going to have a thousand boffins and bureaucrats peering down at them, quite apart from Dr Repacholi and his nasty needles and fields! Hopefully they'll be enduring it all in a good cause, though.

Apart from that, one thing it did seem to show was that despite its admitted 'vested interest', the Electricity Supply Association of Australia is prepared to fund research into the possible health risks of ELF fields, and is well aware of the need to ensure that research funded by them is impeccably objective. That at least *is* reassuring, don't you think?

Oh — did you note that bit about the poor electricity authorities being 'compelled to provide ever-increasing amounts of power'? I certainly did, and I don't think that it should pass without comment. I would have thought if the electricity authorities were doing their job responsibly, they'd be showing us all how we can take advantage of new technology to increase our energy usage *efficiency*, and hopefully use LESS energy in the future — not just blithely accept that their energy empires are going to keep growing indefinitely.

CFL critic

But moving on again, I've had another letter on the subject of the pro's and con's of compact fluorescent lamps. The letter came from engineer Peter King, who runs Procon Technology in Melbourne. Peter takes the opportunity to chip me about not yet using an earlier letter he wrote on the subject, back in September 1991 and in response to my first article about them in that month's Forum. He then goes on to make a few further comments, which I think you'll find interesting.

Somehow I must have overlooked his original letter, a copy of which he has sent again with the latest one. I haven't got room here to give it a belated airing in full, but here are a few excerpts to give to the basic thrust of his argument:

I've been watching with interest the comments about CFL's ever since they were introduced. I had decided that my office light needed changing, since it was on most of the day and much of the night. At that time CFL's were $30 each, however I discovered that a normal fluorescent light fitting costs less than $20, and the tubes less than $3 each. You can see why I decided to go for the normal fluorescent fitting, can't you?

...what about the lounge room at home? Currently we have a fitting with three 60-watt globes; a total of 180W was being burnt for approximately five hours every night — surely CFL's could be used here? Unfortunately NO! The globes used were the small candle-shaped type, and no CFL type is small enough to replace it. Besides, the light has an electronic dimmer, and the CFL cannot be used with a dimmer. This last point is one that annoys me most — few reports (including yours, Jim) mention that the CFL is 'not suitable for dimming'.

Let's try the hallway; these fittings have an incandescent lamp mounted horizontally. The problem with the CFL is the base: it offsets and obstructs the distribution of light. Besides, I wonder about the life of CFL's in completely enclosed light fittings. Also as the hall light is rarely turned on for long periods, ... what's the point of putting a CFL there?

From a practical point of view, I have discovered that the only use for CFL's is in standing lamps and desk lamps. In the case of my work-bench lamp, it not only saves energy, but it dissipates less heat... On the negative side, the larger CFL's stick out the end of the lamp fitting, making the reflector less effective and they don't look as aesthetically pleasing!

On the topic of lamp life, there are many questions. Philips claim that their CFL will last 8000 hours. However, as you suggest, this may be shortened by frequently switching them on and off. I would also suggest that they are affected by their enclosure, and the orientation within the enclosure. Other manufacturers claim only 6000 hours... What is the truth? More than this, what does one do if a CFL does not last as long as they claim — will they replace it? The Philips packet makes no guarantee and provides no address or information on how to make such claims against them!

Many people are purchasing CFL's in the belief that they are doing the environment a favour. However few people have considered the whole equation. Think about the amount of energy used in the manufacture of the CFL! It would be significantly more than for an incandescent lamp — and what about all that plastic and other materials discarded every time you throw a CFL away.

In general I find the CFL over-priced, over-rated and if your only reason for purchasing them is to save carbon dioxide emissions, then you'd possibly do better reducing the use of your clothes dryer by using the natural rays of the sun!

As you can see, Peter was pretty skeptical about the benefits of compact fluoro's, and rather unhappy about not only their cost, but various other aspects — including their bulk and incompatibility with dimmers.

He takes up some of these points in his latest letter, which is fairly short so I can quote it in full:

Since I wrote [the earlier letter], *Australian made CFL's are available with the detachable electronic base — a better, more environmentally friendly solution!*

I forgot to mention, however, that engineers within the SECV consider the encouragement of the use of CFL's as a public relations exercise only! They don't really like the lamps, because of the problems with power factor and the noise/spikes they generate. Comments were also made that they don't last as long as the manufacturers claim — please see my comments in the first letter.

At the present time, I only have one CFL in the house (given to me free). The desk lamp I spoke of has been replaced by a student lamp with a conventional 18-inch fluorescent lamp, costing $2 to $3 for lamp replacement.

A CFL broke recently when my desk lamp fell onto the desk — not helped by the weight of the CFL. That meant $20 down the drain, whereas an incandescent lamp would have cost less than $1 to replace. Big difference!

So there you have a fair summary of Peter's position, I think, from both letters. I can only agree with some of his points, about things like the cost, bulk and weight of compact fluoro's. I too have found that they aren't really compatible with a variety of light fittings, and I've even had one fail after far less than 8000 hours, despite the fact that it was used only in continuous sessions of about 10 hours at a time (i.e., all night), on our staircase landing at home.

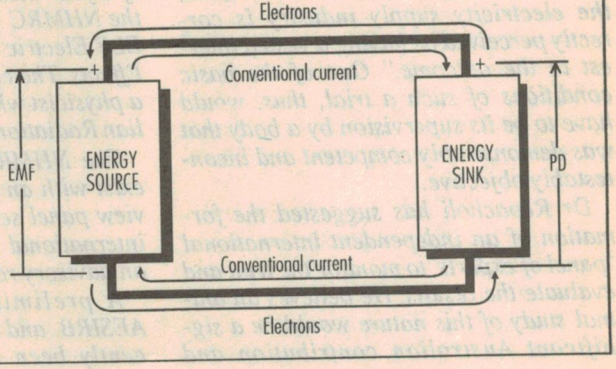


Fig.1: An EMF is associated with a source of electrical energy, while a PD is associated with a 'sink' (a component which is causing energy to leave the circuit). Note their different voltage-current polarities...

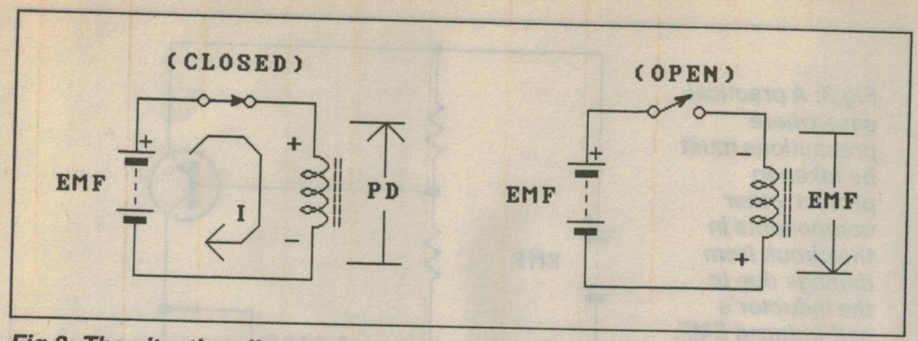


Fig.2: The situation discussed by Mr Comer, where an inductor is connected to a source of EMF, and then disconnected. Is a 'back EMF' generated?

All the same, I'm a bit surprised by Peter's claim that SECV engineers don't really like the lamps, and regard promoting them as 'only a PR exercise'. If the reason for this is the power factor/harmonics problem, as he says, that suggests that they must also be pretty lukewarm about personal computers, many modern TV sets and a lot of other electronic gear!

Anyway, thanks for your letters, Peter. It's clear that compact fluoro's have their down side, which their promoters aren't too keen to tell us about...

'Nix' to back EMF!

To change the subject again, our last letter this month comes from Mr Arthur Comer, of Frankston in Victoria. Mr Comer seems to be an experienced electronics teacher, and he has a 'thing' about references to 'back EMF', when people are talking about the voltages produced by inductors. By the way, the 'EMF' being referred to here is electromotive force, not electro-magnetic fields. Anyway, here's what Mr Comer has to say:

The other day, while browsing through a university physics textbook, I came, once again, on my favourite 'hate': a reference to 'back EMF'.

I have seen references to back EMF in many textbooks, and in almost every case it was obvious the writer did not understand the subject he/she was writing about. There appears to be great ignorance of the difference between EMF and PD. My own definition, which accords with the better texts on the subject, is than an EMF imparts energy to electrons, while a PD extracts energy from electrons.

If we apply a DC voltage to an inductor (as per the above textbook), we DO NOT generate a 'back EMF'. While the inductor is charging it has a PD across it, and current rises at a rate such that, at any instant,

$L.di/dt + I.R_{int} = V_{supply}$

Since the inductor is accepting energy from the supply, it is clearly a PD, not an EMF — exactly as if it were a capacitor or resistor.

When the circuit is broken, the collapsing field becomes an EMF, creating a large PD across the inductor until the energy in the electric field, plus resistance loss, equals the value $LI^2/2$ at the instant the circuit was broken. This 'EMF of self-induction' is not a 'back EMF', since it maintains the original direction of current.

When an inductor (or capacitor) is connected to an AC supply, the circuit EMF and PD change places every 90 degrees. While the inductor is charging (current increasing) it is the PD, with the supply being the EMF. When the inductor is discharging (current decreasing) it is the EMF, and the supply becomes the PD. But since the inductor (or capacitor) voltage is always the same polarity as the supply (i.e., positive to positive, and negative to negative), neither should be called a back EMF. Both elements simply store and return energy.

When I started teaching electronics theory thirty years ago, I talked about 'back EMF' too, but soon recognised what a nonsense it was and discarded the term. I wish all other teachers and writers would do likewise. (Well, you did ask for topics of interest. I hope this is.)

It's certainly of interest to me, Mr Comer, and I'm sure it will be to quite a few other readers as well. Thanks for writing in about it.

What do you think then, folks? The term 'back EMF' is certainly one that many of us (me included) use quite a bit, often without giving a great deal of thought to whether it's really appropriate. In that sense Mr Comer has no doubt done us all a favour, in forcing us to examine what we've been doing.

At the same time, I'm not at all sure that I can follow, or agree with, everything he says.

I have no real problem with his basic definitions of an EMF and a PD; I too have always thought of a EMF as being associated with energy entering a circuit and being imparted to electrons, while a

PD is associated with energy being extracted from the electrons and leaving the circuit — often in the form of heat. Nor do I have any argument with him when he talks about the PD associated with an inductor to which a DC source has been applied; the inductor is accepting electrical energy, and converting this into both magnetic field and heat.

Where he does start losing me is when he describes what happens when the circuit is broken, and the field in the inductor starts to collapse. As he says, this induces an EMF in the inductor, which he calls an 'EMF of self-induction'; fair enough. But then he seems to insist that this is *not* a back-EMF — because 'it maintains the original direction of current'. He also seems to somehow want to convert it into a PD, as a result of interaction with the inductor's own self-capacitance and its internal resistance.

Are we wrong, as he says, to call this EMF — induced in the inductor by the collapsing field — a 'back EMF'? Frankly, I don't think so.

It's true that the polarity of the induced EMF is such that it attempts to maintain the original direction of current. However a big difference between an EMF and a PD, as I suspect Mr Comer would agree, is that the voltage and current have the opposite relationships — because of the fact that energy is entering the circuit in one case, and leaving it in the other.

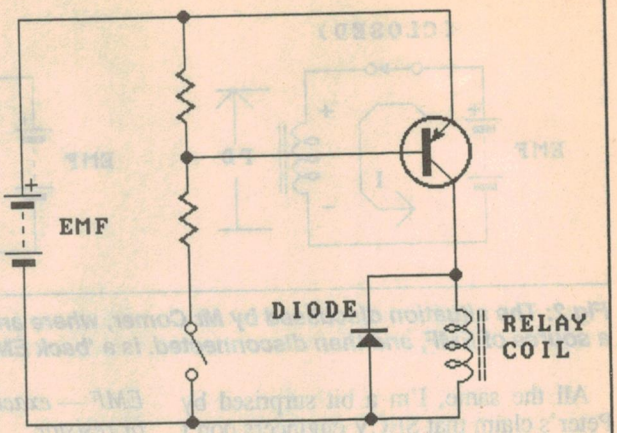


Fig.3: A practical case where precautions must be taken to protect other components in the circuit from damage due to the inductor's self-induced EMF. Considering the polarity of the diode, is it a 'back EMF'?

When you have a source of EMF, like a battery, delivering energy to a circuit the current flow is such that electrons will be leaving the negative electrode, and returning to the positive electrode. Or in terms of 'conventional' current flow, current will be leaving the positive electrode and returning to the negative electrode. This is all in agreement with the idea that the source of EMF is *supplying* energy to the circuit.

Conversely with a circuit component across which a PD is developed, like a resistor, the situation will be the exact opposite. Electrons will be entering the negative electrode, and leaving at the positive electrode; or if you prefer, 'current' will be entering at the positive electrode and leaving at the negative electrode. Again, this is consistent with the idea that a PD is associated with energy *leaving* the circuit — i.e., an energy 'sink'.

Fig.1 illustrates this first point. Now with this in mind, what can we say about the situation where an EMF is induced in our inductor, when the field starts to collapse?

The induced EMF certainly attempts to maintain the original direction of current flow, as Mr Comer says. But the original direction of current flow was through it *when it was absorbing energy and developing a PD*. NOW the inductor is the source of EMF — so in order to try and maintain the current in the same direction, its own EMF has to have the **opposite polarity** to its earlier PD!

This is illustrated in Fig.2, and of course it's well known that this polarity reversal occurs. If you pass some DC through an inductor as shown, and then turn off the current, the voltage 'kick' induced in the inductor is not only very large, but definitely has the opposite polarity to the inductor's original voltage drop when the current was flowing.

Well then — why shouldn't we call this induced EMF, whose polarity is opposite to the original voltage drop, a 'back EMF'? I for one can't see any objection to this; all we're doing with the term is reminding ourselves that the EMF polarity is reversed with respect to the inductor's normal PD.

Why Mr Comer objects so strongly to it, I'm at a loss to understand. But presumably all that means is that he'll now lump me in with the writers who 'do not understand the subject he/she is writing about'...

Still, it looks as if I'm in pretty good company. Just about every circuit that has ever been published for a transistor relay driver includes a diode across the relay winding, to prevent the inductive 'spike' from damaging the transistor. And in virtually every circuit, the diode is connected as shown in Fig.3. This is so that it doesn't conduct when the relay coil is passing the normal operating current, but only when the transistor turns off and the coil's stored energy induces an EMF in it — with the reverse polarity to the PD.

I don't like your chances of being able to protect the transistor if you connect the diode in circuit the other way around, folks. A zillion circuit designers can't be wrong, surely. And that being the case, I for one intend to still keep referring to that voltage spike that is induced in the inductor a 'back EMF'!

In fact I can't think of a situation where the term 'back EMF' would be more applicable...

But what do other readers think — is there something in Mr Comer's argument that I'm missing? By all means let me know if you believe I'm wrong. ❖

When I Think Back...

by Neville Williams

Australian radio factories: frequently recalled but sparsely documented!

Old timers often re-live their personal experiences in Australian 1930's-style radio factories, unmindful of the fact that a formal record of many such enterprises has never been compiled. This is regrettable because, at a time when tertiary education was an exception rather than the rule, those same factories provided basic training for a whole generation of recruits to a career in electronics. Stromberg-Carlson (A'sia) was a case in point.

My original intention in tackling this theme was to adopt a broad approach, involving mainly factories mentioned by correspondents who had made it from assemblers, wirers and testers to meaningful positions in the electronics industry — and/or later in the armed forces!

My plans, however, were side-tracked by — of all things — a news item relating to the last Melbourne Cup! On the day before the Cup was run, the *Sydney Morning Herald* carried a group photo of the Freedman family, who had entered three horses in the race, one of which — 'Subzero' — proved to be the eventual winner.

Not a 'horsey' type, I wouldn't have given it a second thought had not the article mentioned that the grandfather of the clan was Allan Freedman: 'a Yale graduate employed by Stromberg-Carlson' (USA) who had come to Australia in 1927 'to start wireless here'; this, presumably, was on behalf of the aforesaid company.

In the normal way, the name would have meant nothing to me but, coupled with Stromberg-Carlson, it stirred a faint recollection of once having heard of an 'Al Freedman' in that context.

Over the years, I'd often wondered about 'Strombergs' and the relationship between the American and Australian companies; here was a possible clue. Who better to check with than Fred Thom of Tasma — featured in the September-October 1992 issues — who had been associated with Stromberg-Carlson (A'sia) Ltd in its formative years.

Sure enough, Fred Thom remembered Al Freedman well — from about the time L.P.R. Bean & Co changed their name to Stromberg-Carlson (A'sia). "He was a nice bloke", said Fred, "and, yes, he was interested in race horses, even then; in fact, I think he bought one soon after his arrival!"

Fig.1: Leslie Percival Reed Bean, Managing Director of Stromberg-Carlson (A'sia). (Picture by courtesy of the IREE (Aust.)

Next morning, Fred rang back to say that he had remembered the name of Al Freedman's first Aussie horse; it was called 'Helmsman'. For an 88-year-old, that's not a bad feat of memory!

From fellow history buff Colin Mackinnon came the further information that Al Freedman was also a keen fisherman, while *EA* Editor Jim Rowe came to light with the photostat of an article by Allan H. Freedman (sic) in the Australian magazine *Radio* for November 11, 1928 entitled: 'The Practical Development of Television'.

To do with the now-obsolete mechanical system, it detailed experiments being carried out by radio station WRNY, New York. (Fig.2)

As one observation led to another, I realised that Stromberg-Carlson (A'sia) was a prime example of a company which had inspired lots of anecdotes and comment, but little in the way of formal history. Perhaps the time had come to set in order the information that we had.

Australia-America link

As indicated in the Fred Thom story (*EA*, September 1992, pages 30,31), Stromberg-Carlson (USA) had been represented in Australia by L.P.R. Bean & Co from the early 1920's, mainly in respect to telephone equipment and radio headphones.

Because L.P.R. Bean seemed intent on promoting Australian manufacture, Stromberg-Carlson had moved to capture some of the action by buying into L.P.R. Bean & Co, which forthwith became Stromberg-Carlson (A'sia).

Fred Thom was unsure of the role of Al Freedman or the financial structure of the reconstituted company, but two things were certain: L.P.R. Bean himself

(Fig.1) retained the position of Chief Executive Officer, while Al Freedman joined the permanent staff as Sales Manager, reporting to Bean.

Fred also recalled how the company had veered from a preoccupation with telephone components to the importation and (later) manufacture of radio receivers, which necessitated expansion of their facilities.

In fact, it was the very prosperity of the venture which prompted Fred Thom and a couple of associates from Strombergs to start up a rival company — Thom and Smith (as per the Sept/Oct. 1992 issues).

For whatever reason, however, the parent company's enthusiasm for the investment seems to have been short lived. According to *Mingay's Radio Trade Annual* for 1939 (p.128), they sold most of their shares back to L.P.R. Bean in the following year, 1928, although maintaining an essentially 'paternal' interest.

For me, the story of Strombergs has always been dominated by observations and anecdotes from process workers at workbench level. If I was to present a more balanced picture of the Company, a wider perspective would presumably have to be recovered from old industry publications such as the one mentioned above.

But that's the way it seems to be for many such companies, with former executives inaccessable or deceased and documentation becoming ever more elusive.

'Fifteen bob' a week

Fortuitously, with Allan Freedman still fresh in mind, two letters arrived unheralded on my table. One came from Clive Robbins of Cromer NSW, who was a process worker at Stromberg-Carlson in its early days.

The other, containing a wad of photostats was from Darryl Kasch of Maryborough, Qld. A keen member of the Historical Radio Society, Darryl seems to have an uncanny perception of what might prove helpful at any given time.

Amongst the photostats was a long article from the *Radio Retailer of Australia* (October 16, 1936 p.4) entitled 'Prime Minister Opens Stromberg-Carlson's New Factory'. The sub-title read 'Company Makes Remarkable Progress', the article reflecting its progress to that point. In short, I had to hand prime examples of anecdotal and documented history, covering mainly the early 1930's.

First the anecdotal, which is deliciously typical:

Clive Robbins says that he left school in 1929 which, like 1992, "wasn't the best time to be looking for a job"!

Radio was the only industry that seemed to be going anywhere, and Clive managed to pick up a job at Stromberg-Carlson (A'sia). They were building a neutrodyne receiver, at the time, in a steel box measuring about 18(W) x 12(D) x 8(H) inches. Boasting an 'old gold' finish, it was liberally coated with a greenish 'gunk' and gold paint.

The set came complete with a paper cone loudspeaker which perched on the lid and was marketed as an 'all electric radio', to Clive's knowledge the first Australian receiver of its kind. He continues:

The factory, on the corner of Park and Riley streets, Woolloomooloo, had two floors, one for the metal work under the control of Jack Smith (later a partner in Thom & Smith, 'Tasma'). On the other floor was a team of kids on fifteen bob a week ($1.50) doing minor and major assembly. The wiring was done by adults, who had to get their own sets going after completion.

We were paid by the hour, and would be stood down temporarily if production was held up for any reason.

(I recall another reader, Ray Brown of North Haven NSW, saying that, in his day they were searched on the way out and fined five shillings for a dry joint!) Back to Clive Robbins:

There was no union to look after our interests. If anyone didn't like the work conditions, tough! You knew that there were fifty others waiting outside for your job.

'Thou shalt not steal'

Clive Robbins agrees that pinching parts was rife, and they were told on one occasion by the foreman that the employees were to be addressed on the subject by the 'big boss'. They were warned that they must listen respectfully and that, if anybody laughed, they would be sacked on the spot.

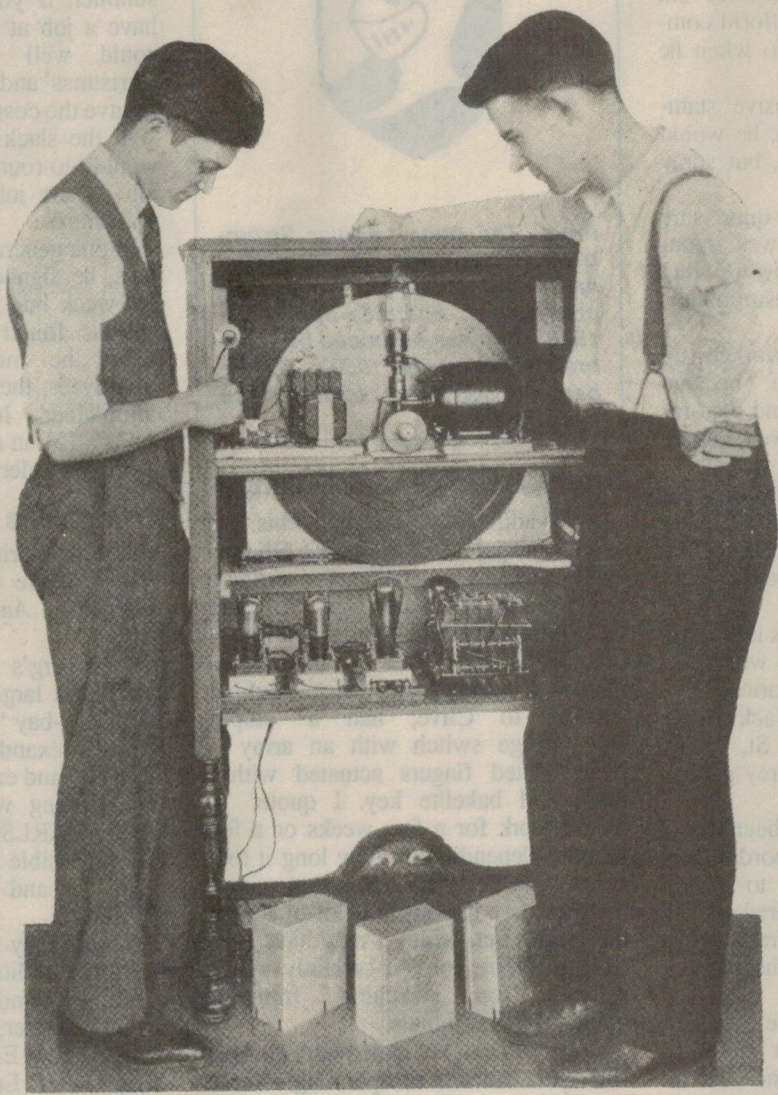


Fig.2: Said to have been involved in the foundation of Stromberg-Carlson (A'sia), Al Freedman took time off to describe experiments in the USA with scanning-disc television in the Australian magazine 'Radio' for November 15, 1928. Shown here is the rear view of a typical receiver.

Describing the scene over the phone, Clive said that this posed quite a problem. He remembers L.P.R. Bean as a stocky man, "about five-feet-three tall and four-feet wide", with a florid complexion that became more so when he got worked up.

He also suffered an 'explosive' stammer such that, when excited, he would not only address employees, but spray them as well!

Clive says he was never quite sure whether 'LPR's' carry-on was spontaneous or 'put-on'. But knowing what to expect, he did his best to restrain himself — to no avail.

As the 'big boss' got worked up about pilfering, his face became progressively more flushed and his oration finally climaxed in one very moist, explosive syllable.

It was too much and Clive burst out laughing — whereupon ten other blokes also 'fell about'. They were all sacked on the spot, cutting short their careers with Stromberg-Carlson.

(I will continue with Clive's letter, because it presents a colourful word-picture of other 1930's-style factories).

By then, Fred Thom and Jack Smith had opened up in Nicholson St, Woolloomooloo, in an old two-storey garage 'down near the wharves'.

The fact that Clive had been fired from 'Strommies' for 'insubordination to big daddy' didn't seem to worry Fred Thom, and he was hired as an assembler. He added that Fred Thom could also 'turn it on' when he got hot under the collar!

In those days, the going rate for first-year assemblers was fifteen shillings ($1.50) per week; for second-year it was 17/6d ($1.75) and 27/6d ($2.75) for third-year. To reach 27/6d, you must have qualified as a tester, being 'too old' for ordinary bench work.

Clive's most vivid recollection from the original Tasma factory was a large vat of fish oil in the downstairs tool room, which Jack Smith had installed for quenching hot metal.

When no one was around, some of 'the lads' used to treat it as a urinal, and the resulting stench when used for its original purpose could permeate the whole place!

Fig.3: The once familiar Stromberg-Carlson logo. The company name and emblem were heavily promoted in Australia during the 1930's but was swamped by other brands during the 1950's. Stromberg-Carlson (A'sia) folded in the early 1960's.

From assembler to manager

As an adult, Clive said he got his 'best ever' radio job at Cliff Black's Olympic Radio as factory manager, for which he was paid the full basic wage. Olympic were producing a dual-wave receiver — one of the first ever on the Sydney market. It sounded magnificent but, according to Clive, had a 'stupid' wavechange switch with an array of nickel-plated fingers actuated with a brass and bakelite key. I quote: "It would work for a few weeks or a few months, depending on how long it took to oxidise!" Olympic persisted with it because they had spent a lot of money on tooling but, while it may have been okay for some jobs, it certainly wasn't suitable for switching front-end microvolt level signals.

Clive said that he argued with his boss and spent several exasperating months developing a compact, self-cleaning rotary wiper switch — only to be beaten to the punch by an announcement from Fox & McGillycuddy that they were importing an even smaller, self-cleaning rotary switch from the USA, produced by Yaxley!

That aside, Clive recalls that radio work was abominably seasonal, with little demand for new receivers during the summer. If you were lucky enough to have a job at the end of the year, you could well be wished a 'Merry Christmas' and sacked on Christmas Eve to save the cost of holiday pay!

In the slack period, process workers would 'go round the traps' looking for a job — any job. You never knew what you'd strike.

In one general engineering firm, Clive says, he signed on for £3/10/0 ($7.00) per week but, on opening his first pay packet, found only £2/10/0 ($5.00). When he mentioned this to other employees, they warned him that, if he complained, he would get: (1) the money, (2) an apology and (3) the sack — in that order!

The coin's other side

And that brings us to the aforementioned article published in the *Radio Retailer of Australia*, for October 16, 1936.

Stromberg's 'new factory' was pictured as a large factory/office complex with a six-bay 'sawtooth' roof in Bourke Road, Alexandria. On the roof of the front bay and extending the full width of the building was the name STROMBERG-CARLSON (A'SIA) LTD — a highly visible landmark from planes flying in and out of nearby Mascot aerodrome.

Attended by 160 prominent identities from the radio and allied trades, the opening ceremony was performed by the Prime Minister, the Rt Hon J.A. Lyons, with the Hon E.S. Spooner, Minister for Works and Local Goverment representing the NSW Premier.

The proceedings were hosted by Mr L.P.R. Bean, described as the Managing Director and Chairman of the Company. The Prime Minister and principal guests were duly conducted on a tour of the new factory by Mr Bean and his co-directors, identified as Messrs Breden, Freedman (also Sales Manager) and Eglon (also Factory Manager).

It is hard to reconcile the industrial 'ogre' commonly portrayed by process workers with the L.P.R. Bean, chief execu-

A cordial relationship? 'Strombergs' in Australia and USA

I would like to express my appreciation of our partners in America, the Stromberg-Carlson Telephone Manufacturing Company.

They have assisted us from time to time not only with respect to technical advice which, by the way, reaches us weekly, but also financially.

They took care of us financially in our infantile struggles and when we were endeavouring to entrench ourselves on the market.

Their assistance is undoubtedly largely responsible for the position we find ourselves in today. I am very pleased to say that all the loans they made to us were paid back some years ago and, for some years past, the Company has owed no money other than the usual monthly accounts.

Today the Company is in a very sound financial position and has moved into this particular factory more as an act of economy than as an act of expansion.

L.P.R. Bean (Managing Director),
At the factory opening, 1936.

tive, pictured in the *Radio Retailer* article. He doesn't even look 'stocky', let alone 'four feet wide' and, in a conservative business suit, was clearly the central figure of the occasion.

The same must be said of the L.P.R. Bean who attended the IRE World Convention in Sydney two years later, in 1938. He was very much a member of the IRE executive group, headed up by Ernest Fisk and responsible for entertaining industry VIP's from overseas.

For good measure, at the time, he was an MIEE (Eng); MIEE (USA); Councillor of the Chamber of Manufacturers; President of the Aust. Radio Manufacturers Patents Association Ltd.; and also President of the Radio & Telephone Manufacturers Association.

Keen on local production

As indicated by Fred Thom (September 1992), L.P.R. Bean had long been an advocate of local production and, in the early 1930's, had found common cause with politicians who supported the use of tariffs to protect Australian industries and jobs. This was in the context of trade concessions favouring Empire countries.

It amounted to the very reverse of policies that prevailed in the mid 1970's, when Australia once again became a nett importer of electronic products.

A contemporary article in *Wireless Weekly* suggested that the effect of revised tariffs would be to give normal quality Australian-made parts and receivers a clear advantage over imports from Holland and Germany, but especially over (I quote) 'cheap and inefficient American radio sets, which were not only driving Australian manufacturers into bankruptcy, but which were creating a bad impression of the quality and operation of radio among the general public'.

Considerable mutual admiration was evident at the opening Stromberg-Carlson's factory: of (1) the politicians for creating a better climate for industrial expansion, and (2) of Stromberg-Carslon (A'sia) and L.P.R. Bean in particular for generating potential jobs for 500-600 employees.

The formalities were chaired by Mr A. Freedman, as a Director and Sales Manager. Curiously, the article describes Mr Freedman as a BSc graduate from Yale University. It goes on: 'He has not been associated with the Stromberg-Carlson Co of Rochester... He has been with the Australian Company since 1929... and is one of (its) leading executives.

Further to cloud the issue, Mr E.H. Spooner, NSW Minister for Works and Local Government, referred in his speech to the role of Al Freedman. I quote:

"We have heard much in the last half hour or so of this company and we are coming more and more to admire its astuteness. We heard first how it relied on our American cousins and brought Mr Freedman here with his capital, and when we had paid him off, he indeed became a freed man and stayed here."

Fig.4: 'There is nothing finer than a Stromberg-Carlson' was the slogan which accompanied this advertisement from the 'Radio Retailer of Australia' for October 9, 1936. Their model 737 was said to be the only receiver in Australia featuring an 'Acoustical Labyrinth' loudspeaker system.

International support

From the USA came a cable from the President of the American Company, Mr W.M. Angle, apologising for his inability to be present in person and renew the pleasant associations he had formed during his visit in 1927. He spoke warmly of the companies in Australia and Canada that now bore the Stromberg-Carlson name.

In his closing response to the overall proceedings, Mr Bean acknowledged the assistance of the American Company in the terms set out in the accompanying panel.

If there appear to be discrepancies in the above, it was possibly because the participants' remarks on the occasion had more to do with bonhomie than historical detail. The dominant theme was that Stromberg-Carlson (A'sia) was on the way up.

A special toast, to the Company and its Managing Director, was proposed by Mr Alf Brash, described as Stromberg-Carlson's oldest Victorian distributor. Speaking on behalf of all distributors, he was unstinting in his praise of the Company, of Mr Bean and Mr Freedman. Their relationship had been "a shining example of how modern business should be conducted", and Mr Bean deserved distributors' gratitude for having stood uncompromisingly against "that greatest evil of our industry" — price cutting.

Of Allan Freedman, Alf Brash remarked, *inter alia*, "...believe me, he pushes most everything. He could sell a jinker to Henry Ford!"

If there was any lingering doubt about the company's attitude to its dealers, it would be dispelled by a news picture in *Radio Retailer of Australia* for May 14, 1937. It depicts a special dinner and conference at 'The Bowery' organised by Stromberg-Carlson for dealers in the Newcastle (NSW) area. It was hosted by L.P.R. Bean and Murray Tyler, a prominent figure in the IREE.

The *1939 Radio Trade Annual* identifies L.P.R. Bean as Governing Director, Allan Freedman as General Manager, Allan W. Scott ASTC as Chief Engineer, and H. Murray Tyler as Sales Engineer, plus a team of backup executives.

So where did Stromberg-Carlson (A'sia) end up, after this high point? In fact, I'm not really sure.

When opening the new factory in 1936, L.P.R. Bean had said that "We (the Australian company) spent liberally in advertising the name of Stromberg-Carlson (Fig.3) and were prepared to suffer initial losses inseparable from establishing an ethical policy of merchandising. I think it was in 1932 that we restored all of that lost capital and, with the aid of our able distributors like Mr Brash, we have been able to come out on a dividend paying basis ever since".

Stromberg-Carlson (A'sia) certainly maintained an appropriate presence in trade literature throughout the 1930's, with the underlying theme of a new sales feature every year (Fig.4).

Their circuits were also routinely published in post-war service manuals but, despite media involvement, my recollections of the company in the latter period are sparse, suggesting a sharp reduction in promotional publicity.

Questions directed to other oldtimers indicated a similar lack of awareness,

postwar, and I can only assume the Company's early committment to promoting its name, image and product had waned. Two of those questioned remembered rumours that Strombergs were 'strapped for cash'. Doug Brown, Electronics Manager for Grace Bros post-war, recalled that Stromberg receivers were not in strong demand on the sales floor.

Having in mind Fred Thom's story of how Tasma had suffered during the war, it is not unreasonable to assume that Stromberg-Carlson (A'sia) may also have suffered a similar financial setback from the 'cost-plus' system.

What is not supposition is that, in 1961, one of their representatives rang me at the *Radio, Television & Hobbies* office to ask whether we would be interested in describing a small build-it-yourself electronic organ, using parts which Stromberg-Carlson (A'sia) could supply ex stock.

In principle, I said, we most certainly would. There was a lot of interest in the subject amongst our readers and the opportunity to access a proven design, along with console, keyboard, and other special hardware seemed too good to pass up. But, I asked, how had this opportunity arisen?

The short answer was that Stromberg-Carlson (A'sia) had indeed run into a serious cash crisis. Over the years, I was told, they had become heavily involved in the production and supply of unbranded receivers, to companies which marketed them under their own trading name.

This had led to a diminished emphasis on marketing under the Stromberg-Carlson banner, with a consequent reduction in direct access to the retail market. When savage competition shaved retail and factory profit margins to uneconomic levels, Stromberg-Carlson (A'sia) were faced with cumulative losses. What's more, the problem had carried over into the B&W television era, with the Stromberg-Carlson identity diminished and other companies like A.W. Jackson and KGH dominating the unbranded market.

Casting around for a back-up product, Stromberg-Carlson (A'sia) had reached agreement with America's Thomas organ company to take over an inexpensive valve-based design, which could conceivably find a ready market in Australian homes and small churches. Their idea was that it would set the scene for a more ambitious Australian designed two-manual solid state model.

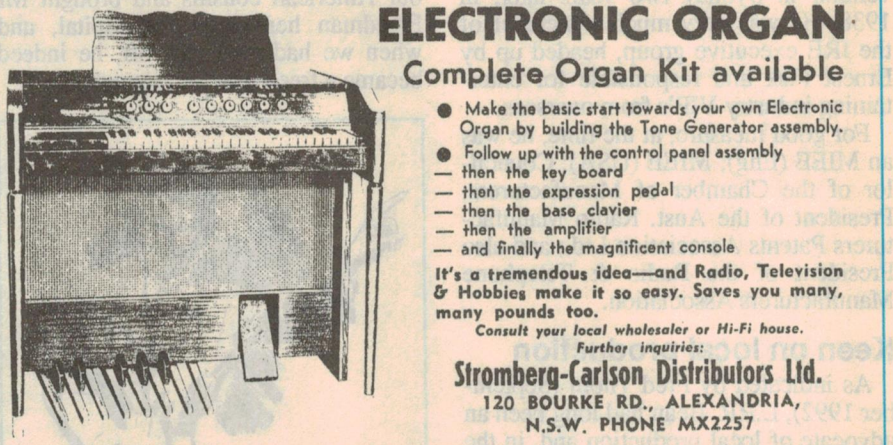


Fig.5: Too little, too late. With little demand for their radio and TV products, Stromberg-Carlson (A'sia) attempted to diversify into electronic organs with the cooperation of the Thomas Company. They finished up disposing of their component stocks to R,TV & H hobbyists, to construct the 'Stromberg-Playmaster' adaption.

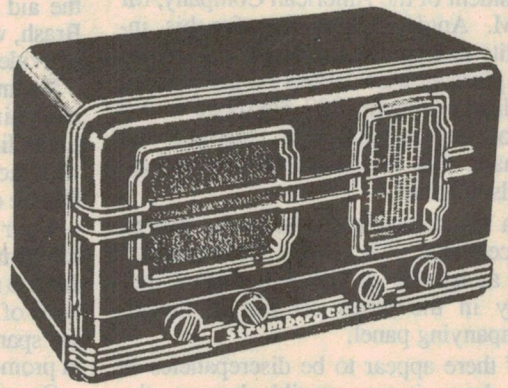
They were serious enough about the project to produce promotional material (Fig.5) and an owner/service manual, and to begin work on its 'big brother'. However, marketing of the single manual instrument had barely commenced when the company was wound up anyway!

As I saw it at the time, the diversion of component kits to *R, TV & H* readers was a last-minute brainwave by Stromberg-Carlson engineer/organ buff Neville Oates and demonstrator/salesman Bob Swann to divert surplus stocks of organ parts from the tip to the homes of technically minded organ buffs.

In the final wash-up, the prototype of the two-manual model was also acquired by spare-time organ enthusiast Doug Brown of Grace Bros, mentioned earlier.

Ironically, the advert that appears in the May, 1962 issue of this magazine (Fig.5) was the only publicity I can recall having handled for the company — being a by-product of their collapse.

The last word in this sorry tale belongs to Fred Thom. Fred offered no opinion as to why Stromberg (A'sia) folded, beyond the broad assumption that: "when Bean died, the Company simply lost its way". Relating to a man who copped so much anecdotal flack from the factory floor, that sounded like a spontaneous tribute from one of his industry peers! ❖



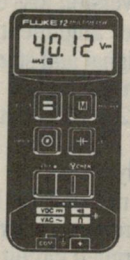
Launched as the 'Surprise of 1937', Stromberg's first — and possibly Australia's first — moulded Duperite cabinet came in old ivory, lime green or dapple brown and was available with a 5-valve chassis, either dual wave or broadcast band only.

OBIAT PTY LTD YOUR ONE STOP DISTRIBUTOR OF TEST & MEASURING INSTRUMENTS

Fluke 10 Series

• V Chek™ for continuity/ohms. Most of the time it's all you'll need! • Min/Max recording with relative time stamp and Continuity Capture™. •Manual/Autoranging • Auto Sleep Mode shuts down • Cap's from 0.001 to 9999µF. • Safe to UL1244, IEC1010, CSA, VDE • Fast and accurate to 600Vac or dc plus ohms to 40MΩ

Fluke 10



• 4000 count digital display • 1.5% basic Vdc accuracy • Fast continuity beeper • Diode test • Sleep Mode • Two year warranty

$95.00 ex tax ***$111.00 inc tax***

Fluke 11

• Adds V Chek™ • Capacitance 0.001 to 9999µF • 0.9% basic dc volts accuracy

$120.00 ex tax ***$140.00 inc tax***

Fluke 12

• Adds Min/Max recording with relative time stamp • Continuity capture™

$145.00 ex tax ***$169.00 inc tax***

Fluke 70 Series

• Automatic TouchHold™ • Diode Test & Audible continuity • TL75 Test Leads with Hard Points™ • Sleep mode • 79/77/75/73/70 for measurements to 4800V-A • 29/23/21 for higher energy

Fluke 70-II

• 3200 count digital display • 31 segment analog bar graph • 0.5% basic accuracy • 2000 hour battery life (alkaline)

$125.00 ex tax ***$145.00 inc tax***

Fluke 73-II adds

• 0.4% basic Vdc accuracy • 10A current

$185.00 ex tax ***$215.00 inc tax***

Fluke 75-II/21-II adds

• 32mA current range

$270.00 ex tax ***$313.00 inc tax***

Fluke 77-II/23-II* adds

•0.3% basic Vdc accuracy • Holster/Flex-Stand™

$295.00 ex tax ***$342.00 inc tax***

Fluke 79-II/29-II* adds

Frequency Counter • Capacitance • Lo-Ohms Range with zero calibration • Smoothing™ • 4000 count digital display (9999 count for frequency and capacitance) • 63 segment bar graph • 0.3% accuracy • 4mA current

$370.00 ex tax ***$429.00 inc tax***

FREE Soft Carry Case with all Fluke DMM's and Philips 90 Series

FLUKE

Made in USA

Fluke 80 Series

• Min/Max/Average recording stores highest, lowest and true average of all readings • Selectable response time to record turn-on surges or drift etc • 1ms peak Min/Max hold on 87 to capture elusive transients or half-sine surges to 400Hz • Audible Min/Max Alert™ signals readings above or below previous limits • Splash and dust proof and impact resistant case

Fluke 83*

• Volts, Amps, Ohms, diode test, continuity, frequency and duty cycle, capacitance, Touch Hold™, relative, protective holster • 0.3% basic dc accuracy • 5kHz Vac • Analog bargraph with zoom • 3 year warranty

$450.00 ex tax ***$522.00 inc tax***

Fluke 85*

• 0.1% accuracy • 20kHz Vac

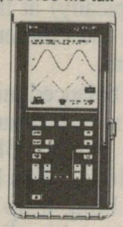
$530.00 ex tax ***$615.00 inc tax***

Fluke 87*

• High resolution analog pointer • True rms ac • 1ms peak Min/Max • 4 1/2 digit mode • Back lit display

$595.00 ex tax ***$690.00 inc tax***

Philips 90 Series 50MHz Digital Storage Scope plus...



• 25MS/s 2 ch. dig. storage
• 8-bit,25 levels/div vert. resolution
• 10ns/div to 5s/div
• Store 8 waveforms (95/97) and 10 set-ups (97)
• Measuring cursors (95/97)

... 3000 count DMM

• Functions include Min/Max, Touch Hold™, Relative & %, Autoranging
• dBm, dBV and dBW (95/97)
• 5 Soft Keys/Pop-Up Menus
• 12cm 240x240pixel Super Twisted Nematic LCD screen
• Floating up to 600Vrms
• Optical RS-232 Port (97)
• Low Power (4 hr int. battery)
• Built-In component and baud rate testers and a sine, square and ramp signal generator (97)

Model 93* Basic instrument
$1695 ex tax, ***$1995 inc tax***

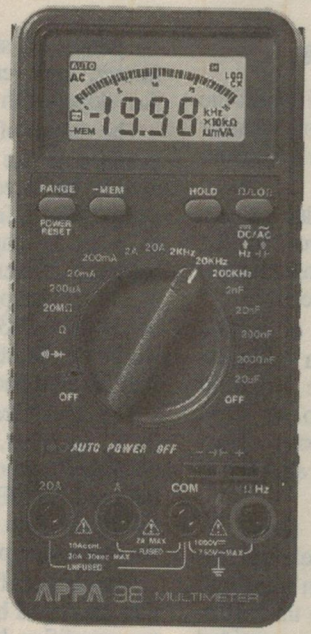
Model 95* Adds measuring cursors and recording function
$2180 ex tax, ***$2565 inc tax***

Model 97* Adds waveform and set-up memories, back-lit LCD, signal generator, RS-232 interface
$2790 ex tax, ***$3280 inc tax***

**** Holster included as standard with these instruments***

We are now stocking the APPA range of quality Multimeters so now your choice is even wider! Call us and we will advise you on the best multimeter for your application. Check our prices too, before you pay too much!

Appa 90 Series



• 3 1/2 digit • 41 segment Analog Bar Graph (96 & 98) • Autoranging •Frequency Counter (98) • Capacitance Range (98) • Data Hold • Memory Offset (96, 98) • High contrast, large digit LCD for easy wide angle viewing (Models 96 and 98 also have an analog bar graph display to easily follow rapidly changing displays) • Unique probe storage holder grips for easy display reading while making two-handed measurements. The holder doubles as a handy storage case for the probes • Auto Power-Off when not in use to extend battery life • Water Resistant – Models 91 & 96 are designed for harsh environments to IP 64 • Shock mounting and thick-wall design guarantee that these multimeters survive a 1.5m fall to a concrete floor • Versatile Tilt Stand swings out to 45° and hooks over a cabinet door or swing the stand out to 90° for a handy level stand • All models are designed to meet Class II IEC 348 and UL 1244 standards for the safest operation in all applications

Model	*91**	*96**	*98**
No of Digits	*3 1/2*	*31/2*	*3 1/2*
Bargraph	–	✓	✓
20A current	–	✓	✓
Capacitance	–	–	✓
Frequency	–	–	✓
Transistor Test	–	–	✓
Offset	–	✓	✓
Data Hold	–	✓	✓
PRICE ex tax	***$109***	***$149***	***$189***
inc tax	***$127***	***175***	***$220***

Appa 23 Digital Engine Analyser

• 8 Functions: Volts, Amps, Ohms, Dwell, Tach, Duty Cycle, Diode Test, and Continuity Buzzer • Large 0.8" digit, high-contrast LCD readout • Automatic power shut off extends battery life • Single rotary switch simplifies function selection • Drop proof • Water resistant

DC VOLTAGE: 200mV to 200V ±(0.5% + 1d)
TACHO: 0-10000 rpm x 10, 0-2000 rpm ±(1.5% + 50 rpm)
DUTY CYCLE: 0 -100.0% , ±(l.5% + 2 d)
DWELL DEGREES: Range: 0-90.0° (4 cyl) 0 - 72.0° (5 cyl) 0 - 50.0° (6 cyl) 0 - 45.0° (8 cyl), ±(l.5% + 2 d)
RESISTANCE: 200Ω to 20MΩ, ±(0.75%+ 4 d)
DIODE & BUZZER: O/C Voltage: 3.2V max.
DC CURRENT: 15A, ±(2.0% + 3 d)

$129.00 ex tax ***$151.00 inc tax***

Appa 76 RC "Meterplus" Component Tester

• Companion to your multimeter
• Tests resistors, capacitors, trimmers, VR's, Diodes, LEds, Transistors, SCR's, Batteries etc

Brief Specifications

Capacitance: 200pF to 20µF
Resistance: 200Ω to 20MΩ
Transistor Hfe, Leakage, Iceo
Hfe: 0 to 1000 npn/pnp
Iceo: 10nA to 20µA
Diode: Approx forward voltage
LED: Approx forward voltage
Battery:
9V: 15mA load
1.5V 150mA load
1.5V Button 0.8mA load
SCR: Pass/Fail

$129.00 ex tax ***$151.00 inc tax***

NEW 32 PAGE FREE SHORTFORM CATALOGUE AVAILABLE NOW

32 page catalogue and detailed brochures and specifications available. We are factory trained to advise on your requirements for general purpose Test & Measuring Instruments. Ask about our Account facilities and special arrangements for Education and Government Departments. Express delivery can be arranged throughout Australia and South Pacific.

OBIAT PTY LTD

READER INFO NO. 13

129 Queen Street, Beaconsfield. P.O.Box 37 Beaconsfield NSW 2014
Tel : (02) 698 4776 Fax : (02) 699 9170 Call us for name of your local stockist

bankcard VISA MasterCard

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

137MHz downconverter

Having followed with great interest the recent articles by Tom Moffat on Weather Satellite reception, I purchased a kit from him to make my own pictures.

Unfortunately, the bandwidth of my scanning receiver was too narrow for the high deviation transmissions, and attempts to increase it were less than successful.

Faced with the proposition of parting with around $900 for a suitable receiver, I decided to have a go at building a downconverter to the FM broadcast band for feeding into my portable radio/cassette. The circuit attached is the successful result.

The incoming 137MHz signal is amplified by a BF981 N-channel dual gate MOSFET Q1, which has a gain of around 20dB and a noise figure less than 1dB. Low impedance bypassing is provided around this stage and the input matching network is chosen for the best noise figure.

The two coils are wound on 4.83mm formers with F29 slugs, in cans with no bases (DSE L-1010, L-1307, L-1020). They are wound with 1mm diameter enamelled copper wire and double spaced — wind two strands of wire on to the former, then remove one. The coils are then doped with superglue.

The output of the RF amplifier stage is matched to the 50 ohm input port of a double balanced diode mixer (Mini-circuits SBL-1 from Stewart Electronics, $12) by a capacitive divider. Double balanced mixers work best when all inputs and outputs are properly matched, hence the two 3-resistor pi-attenuator networks on the other two ports, to give two 3dB 50-ohm pads.

The double balanced mixer was chosen for its isolation, i.e. the RF and LO (local oscillator) inputs are significantly attenuated (-45dB typically) at the IF port where the sum and the difference of the two inputs are present.

The output of the balanced mixer is further amplified by a simple common emitter amplifier built around UHF signal transistor Q2 (2SC1674). This has a gain of around 15dB to bring it up to a level that most FM receivers in radio/cassettes have no trouble hearing.

The local oscillator stage also uses a 2SC1674 transistor Q3 (DSE Z-6005) and a cheap computer crystal (Rod Irving Electronics, $3 for 48, 36 or 32MHz). With input frequencies from 137-138MHz, the output frequencies for each crystal will be: 89 - 90MHz (48MHz); 101 - 102MHz (36MHz); and 105-106MHz (32MHz).

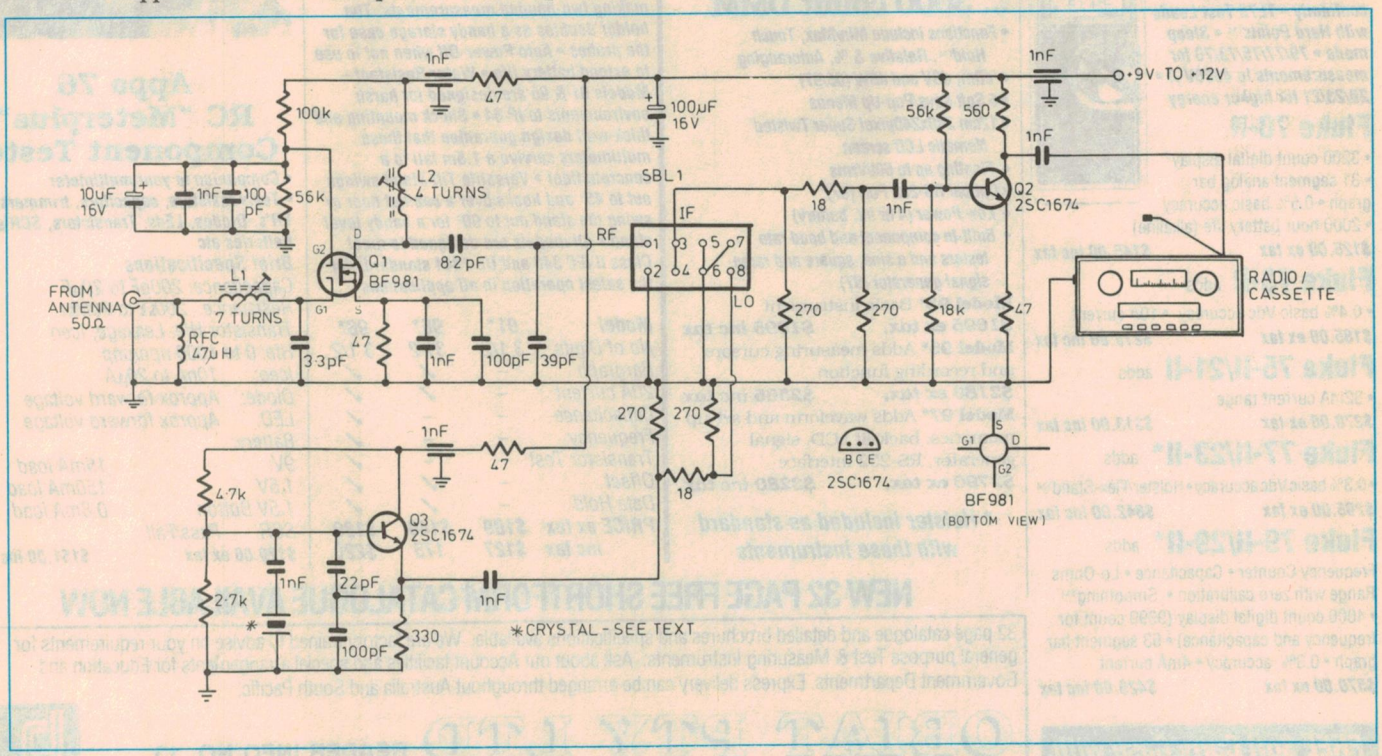
The gain through the converter is such that the RF stage determines the noise figure. Note that the double balanced mixer has a conversion loss of about 6dB.

For the alignment, use a weak incoming signal and start with the slug in L1 level with the top of the former, and the slug in L2 a little out of the former. The tuning of L2 is fairly sharp, while that of L1 is fairly broad.

I built my unit on top of double sided copper circuit board, not being inclined to make a printed circuit for an experimental one off job. It works quite well with my discone antenna, but I intend building a Lindenblad antenna when time permits.

Two parts of the circuit may need further optimisation: the matching from the RF stage to the mixer input; and the level from the LO fed to the mixer (should be +7dBm).

Ross Dannecker,
Rockhampton, Qld **$50**



Alarm input processor

This is a very simple circuit to condition the input for burglar alarms and greatly reduce the chance of false alarms. The circuit sits in series with the alarm sensor input, is small, and will fit in any small box or in the main alarm box, if desired.

Noise in lines to and from sensor switches, or momentary spurious opening of such switches in alarm systems, can cause false triggering. This circuit eliminates such problems, and should work with any sensor that simply opens a relay (or solid state switch) — for example, magnetic reed switches on windows and doors, or passive infrared (PIR) sensors. It has virtually eliminated problems with occasional false alarms which I used to have with a PIR sensor.

The design takes its input from the sensor and processes it so that it only produces an open circuit at the output when the sensor switch opens either:

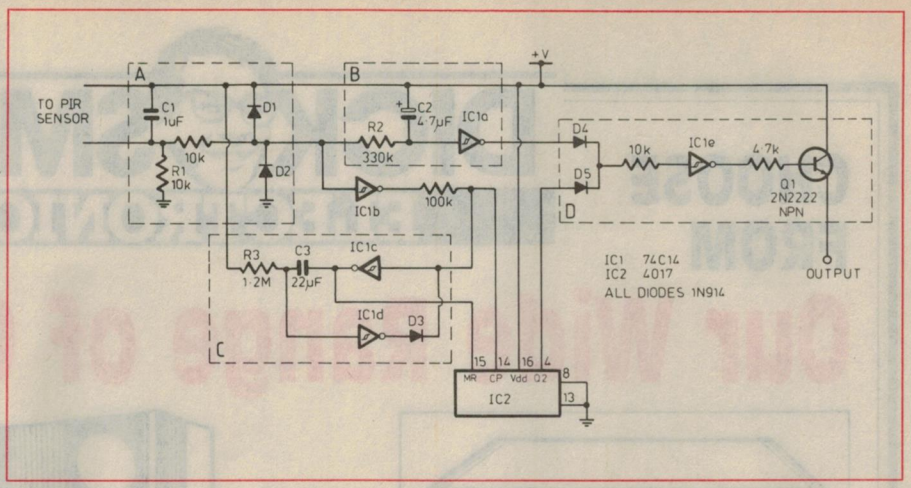
- for more than about 2.5s — this can be altered by changing the resistor/capacitor values in section B; or
- at least three times in 30s — with the number and the set period being determined by section C.

Section A, via diodes D1 and D2, dumps any high voltage spikes greater than +V or less than GND — to provide extra input protection for the CMOS gates of IC1 (74C14). (This IC is a hex inverter, with Schmitt triggers to improve noise rejection.) Resistor R1 and capacitor C1 in this section remove any input lows shorter than a few milliseconds, for example from switch bounce.

Section B generates a high at the output of IC1a if the input sensor switch is open for more than about 2.5s — the time being determined by resistor R2 and capacitor C2. Similarly, section C generates a high output if the sensor relay opens at least three times in 30s. This timing period is determined by resistor R3 and capacitor C3, with the count set by the 5-stage Johnson counter. The counting function operates as follows:

As soon as the input switch opens, a high is generated by inverter IC1b, which in turn is further inverted to become a low at the output of IC1c. As a result, the both sides of capacitor C3 immediately go low, then the positive side begins to charge via resistor R3. This low is also fed back via inverter IC1d (and diode D3 to prevent reverse current flow in the opposite state) to generate and maintain a high at the input of the first inverter IC1c. Hence, charging continues for a full cycle, no matter how long or short a time the input switch stays open.

At the end of the 30s period, the now



charged C3 flips the output of IC1d, which in turn sends the output of IC1c high, resetting the counter IC2 (4017) via the master reset pin 15.

Before this pin goes high, any low-to-high pulses at input pin 14 advance the counter. Since the output of IC2 is connected to pin 4 (Q2), it goes high on the second count — provided that the pulses occur within the 30s timing period. Note that Q2-high occurs on the third open circuit of the input sensor, even though it is only the second count.

The first sensor pulse activates the timing circuit and de-activates the master reset on pin 15 — it does not clock the counter. If higher pulse counts are required, a different output pin on IC2 can be selected.

Section D is the output stage. It consists of a logic OR gate built around diodes D4 and D5. A high at either input will activate the alarm. This is done via inverter IC1e which turns off the NPN transistor driver Q1 (2N2222), generating a low at OUTPUT.

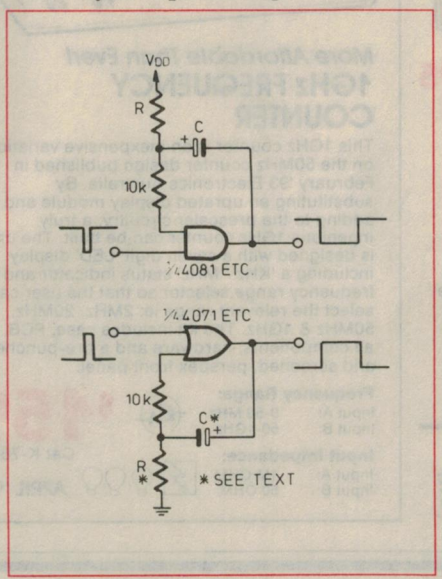
A resistor can be added in series to the output, if desired, to protect from shorts, provided that the alarm will still function properly. Try it and see.

Since the ICs are CMOS chips, current drain is very low, and the circuit will run on a wide range of supply voltages up to 20V (mine runs on 12V). The power should be drawn from the supply line of the infrared sensor, or if not available, from the main supply for the alarm circuit itself. Remember to tie the input of the unused sixth inverter of IC1 either high or low to stop high frequency cycling.

Glenn Pure,
Kambah, ACT **$45**

CMOS one-shots

Often in CMOS circuits a 'one-shot'/pulse stretcher/monostable multivibrator function is required, and the usual way of implementing this is to use a dedicated IC such as a 7555 or 4528, etc. But if a spare AND or OR gate is available, one of the circuits shown can be used with stable, predictable results in a timing range from a few microseconds to many seconds.



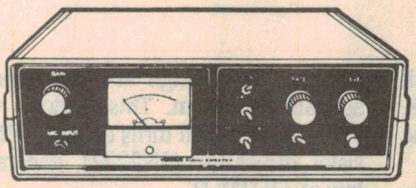
The circuits work by simply feeding back the output logic level to one input until capacitor C charges to about half the supply voltage via resistor R. The time constant equals approximately 0.6RC.

Resistor R needs to be kept above about 10k, and can be easily made several megohms thanks to the almost infinite input resistance of the CMOS gate, while C can be almost any value. The 10k resistor ensures that the output switches rapidly at the end of the output pulse, as well as limiting the current through the input protection diodes of the gate. But if C is less than about 0.1uF it can usually be deleted. Note that if an AND or OR gate isn't available, this circuit will work with a NAND/NOR gate followed by an inverter.

Bob Parker,
Carlton, NSW **$35**

CHOOSE FROM DICK SMITH ELECTRONICS

Our Wide Range of Quality Kits!



Tests Your Sound System!

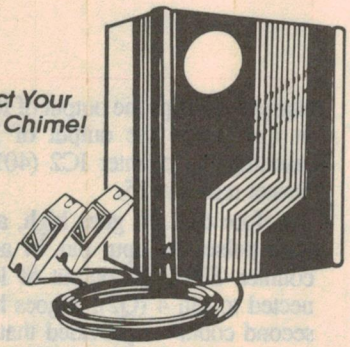
AUDIO SWEEPER

A useful kit for audiophiles, sound experts, enthusiasts and anyone interested in sound. This very affordable audio test system analyses the performance (treble, mid and bass range) of speakers, speaker enclosures, filter circuits and room acoustics. It consists of a sweeping audio test signal generator and a metering amplifier which measures the results. Comes complete with deluxe pre-punched front panel, plastic instrument case, PCB, hardware (including dB meter), components, mic. insert and plug pack.
Cat K-7352

SEPT '92

$109

Select Your Own Chime!

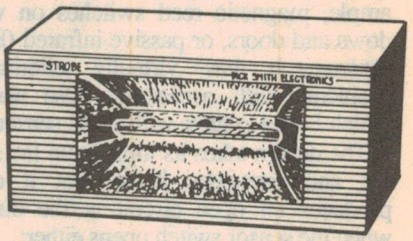


PROGRAMMABLE DOORBELL

Lets you program your own doorbell tune. With a maximum of 14 notes possible, it can even play two different tunes - one for the front door and one for the back and, if you get sick of a tune, you can change it! The kit comes complete with all components and hardware including battery holder, PCB and a deluxe doorbell case. Back doorbell switch is optional. (Batteries not included)
Cat K-3802

APRIL '93

$39.95

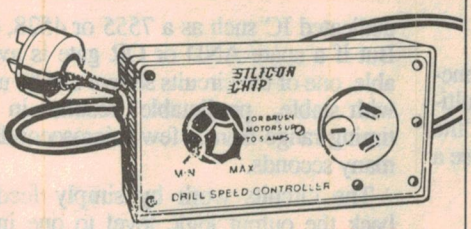


DISCO STROBE

Just the thing for your do-it-yourself disco outfit! This reliable kit provides a high-energy flash of white light which you can vary from 1-10 flashes/second. It's triggered by either an external source or its own internal oscillator and has both input and output trigger connectors, so that any number of these units can be linked to flash in synchronisation. Comes with all components, hardware, PCB, deluxe plastic case, screened perspex front panel, linear 100mm Xenon tube and a commercial high-efficiency reflector.
Cat K-3155

DEC '92

$129



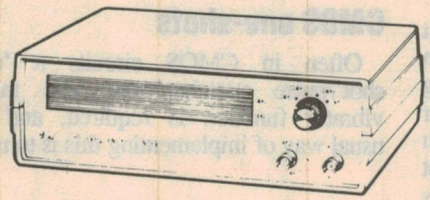
Easy-To-Build!

MOTOR SPEED CONTROLLER

$46.95

A kit designed to regulate the speed on heavy-duty power tools. It's ideal for circular saws, electric drills, lawn edgers, jig-saws, sanders, grinders and other equipment rated at 5 amps with a 'brush' type motor. This improved design has a higher current rating and uses a Triac rectifier instead of an SCR. It also monitors the back-EMF voltage from the motor so, though the drill speed is controlled, it won't bog down when the going gets tough. Complete with deluxe pre-punched black anodised screened front panel, components, PCB and flush-mounted mains socket.
Cat K-3085

PLEASE CHECK YOUR NEAREST STORE FOR AVAILABILITY, AS SOME KITS MAY STILL BE IN PRODUCTION.



More Affordable Than Ever!

1GHz FREQUENCY COUNTER

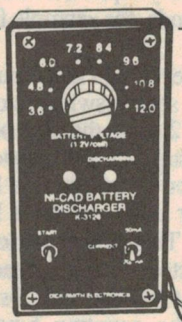
This 1GHz counter is an inexpensive variation on the 50MHz counter design published in February '93 Electronics Australia. By substituting an uprated display module and adding to the prescaler circuitry, a truly ingenious 1GHz counter can be built. The unit is designed with a seven digit 'LED' display including a 'KHz'/'MHz' status indicator and a frequency range selector so that the user can select the relevant range ie: 2MHz, 20MHz, 50MHz & 1GHz. The kit includes case, PCB, all components, hardware and a pre-punched and screened, perspex front panel.

Frequency Range:
Input A: 0-50 MHz
Input B: 50-1GHz

Input Impedance:
Input A: 1M OHM
Input B: 50 OHM

$159
Cat K-7604

APRIL '93



Get More Out Of Your Batteries!

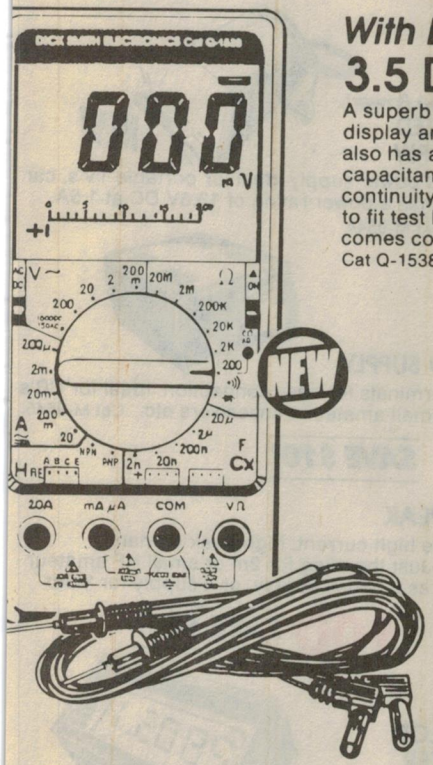
NICAD BATTERY DISCHARGER

$34.95

Get the best performance from your Nicads with this battery discharger by beating the "memory effect". With switchable voltage (3.6, 4.8, 6.0, 7.2, 8.4, 9.6, 10.8 & 12V) and automatic cut-off. This easy to build kit is ideal for most types of Nicads as used in cam-corders, cordless phones, radio controlled cars, cordless drills, and laptop computers, etc. The unit continuously monitors voltage and automatically cuts off the discharge current once the battery as a whole is fully discharged. As well, there's a switchable current discharge of 50mA and 200mA and a push-to-start button. This full form kit has all components, hardware, case and a pre-punched black anodised screened front panel.
Cat K-3126

NOV '92

For The Latest In Technology...



With Large LCD Display!

3.5 DIGIT MULTIMETER

A superb 3.5 digit multimeter with large 25mm display and a 20 amp AC/DC current range. It also has auto power off, bargraph display, capacitance meter, transistor tester, diode and continuity tester. The multimeter has side slots to fit test leads for one-handed operation and comes complete with tilt stand and carry case.
Cat Q-1538

Ranges:

DC V:	200mV,2 ,20, 200, 1000 volts.
AC V:	200mV,2 20, 200, 750 volts.
AC/DC current:	200uA, 2mA, 20mA, 200mA, 20A.
Resistance:	200 Ohm 2K, 20K, 200K, 2M, 20M

$159

Put Your Mains Circuit To The Test!

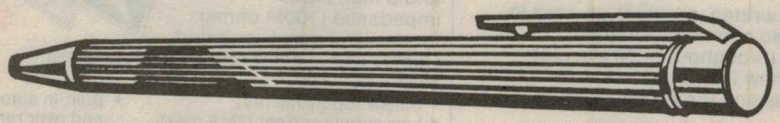
AC VOLTAGE FINDER

Now there's no need to put yourself at risk! This device detects the electromagnetic field surrounding cables, sensing any AC voltage above 120 volts and warns you with both an LED and an audible "buzz". At this low price, there's no excuse for not having one!
Cat Q-1531

$16.95

NEW

The future of Laser Technology...It Points This Way!



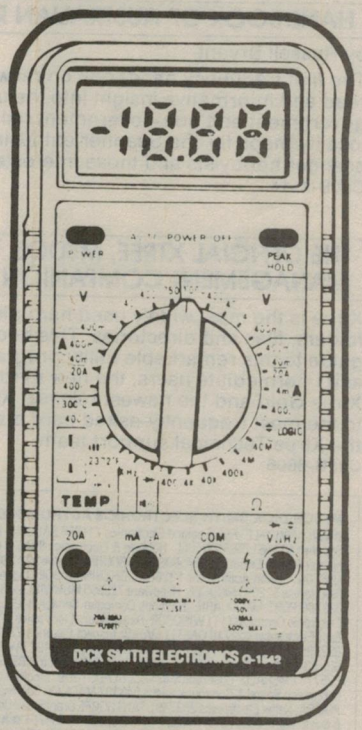
LASER POINTER

This new pen-sized laser pointer reaches far beyond the range of ordinary pointers and serves many useful purposes. It's ideal for medical professionals, professors and lecturers, executives and sales people, realtors, tour guides, construction supervisors and inspectors.

The Laser pointer is also an asset for any photographer as it simplifies difficult dead corner and night shots.
Specifications:
Diode/ < 5mW Max at 680nm
Cat T-2900

DON'T PAY $199

$169



Complete With Holster!

.75 DIGIT (4000 Count) MULTIMETER

rugged meter that's great for both field and orkshop use, it's shock, water and dust sistant, featuring rubber o-ring gaskets on rotary switch, input jacks and case.

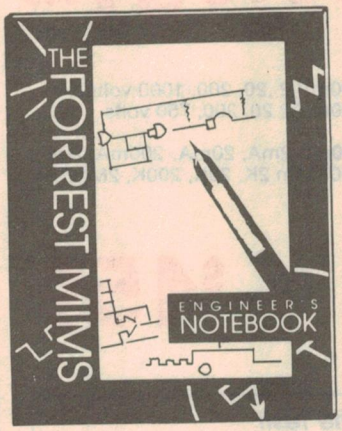
Supplied with a thermocouple probe for temperature measurement from -40°C to 260°C, the meter features most standard ranges plus:

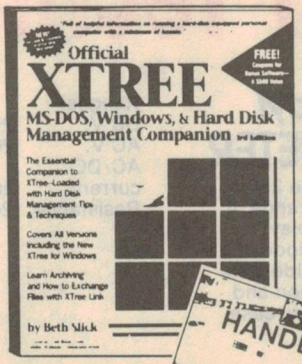
- Continuity
- Diode test
- Logic test
- Frequency (Auto-ranging)
- Temperature
- Peak Hold
- Auto Power off

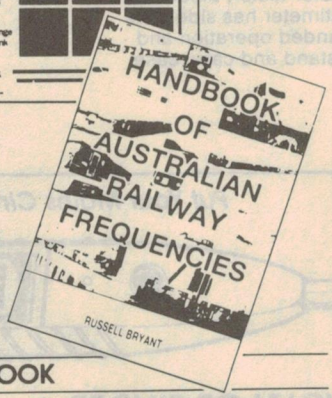
Cat Q-1542

$179

READ ABOUT IT!







NEW

FORREST MIMS' ENGINEER'S NOTEBOOK

A new practical guide based on Forest Mims' years of intensive hands-on experience with IC circuits. It is an essential reference for professional design engineers, educators, technicians, students, circuit hobbyists or anyone else requiring concise, accurate information on chip applications. This one's not for the bookshelf -clear a permanent place for it next to the logic probe and multimeter in your electronics lab!
Cat B-1500

$29.95

HANDBOOK OF AUSTRALIAN RAILWAY FREQUENCIES

by Russell Bryant

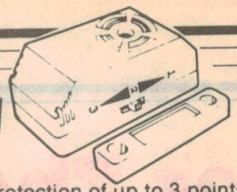
The first frequency handbook on railways ever written, provides an easy to read and informative insight into the use of radio communication on government and non-government rail services throughout Australia plus locality maps for the Scanner enthusiast. This new handbook will delight both scanner hobbyists and those interested in trains and the railway system.
Cat B-4114

$19.95

THE OFFICIAL XTREE, MSDOS, WINDOWS AND HARD DISK MANAGEMENT COMPANION (3rd Edition)

Xtree is the most widely used hard disk management utility for organising folders, files and directories. This book by Beth Slick is the only authorised guide to this remarkable utility program. Recommended for both beginners and intermediate users, the new third edition covers all versions including Xtree Gold and the newest release, Xtree for Windows, and features answers to the most frequently-asked hard disk management questions, straight from the Xtree Technical support team.
Cat B-6606

$39.95



Three-In-One!
MAGNETIC SWITCH MINI ALARM

NEW

A high quality alarm for the protection of up to 3 points, with a distinct sound for each. You'll feel safe with this alarm installed on windows, doors, drawers or any area requiring protection! Batteries included. Cat L-5186

$24.95

You've Got The Power!
UNREGULATED POWER SUPPLY

NEW

A unregulated power supply ideal for portable TV's, car radios, etc. It has a power rating of 13.8V DC at 1.5A. (18V max) Cat M-9544

$49.95

13.8V/1.5 REGULATED SUPPLY

With screw terminals for easy connection. Ideal for CB's car stereos, small amateur transceivers etc. Cat M-9545

$74.95 ***SAVE $10!***

13.8V/4A PEAK

Ideal for those high current, high peak demand applications. Just the thing for 2m or small HF amateur transceivers, as a bench supply, or a supply for 'auto' equipment.
Cat M-9547

$100 ***SAVE $20!***

3.5 DIGIT LCD PANEL METER

'Full scale' of 200mV or 2V (user selectable) and a high input impedance (100M ohms). It can also be self-mounted. Comes with a comprehensive data sheet.

$59.95

Features:
- Single supply rail (9V)
- Low supply current (2MA max)
- Built-in auto zeroing and over range.

Cat Q-2200

3.5 DIGIT LED PANEL METER

Incorporates a dual-slope analogue-to-digital converter and a 100 mV reference with 200mV or 2V full scale sensitivity. 12.7 mm digit height. Auto-zeroing and over-ranging are provided and automatic input polarity indication available. It comes complete with full instructions. Cat Q-2210

$59.95

Features:
- Single + 5V operation.
- Decimal point selectable.
- Zero reading from 0V on all scales
- Input impedance >100M ohms

MAJOR DICK SMITH ELECTRONICS AUTHORISED STOCKISTS:

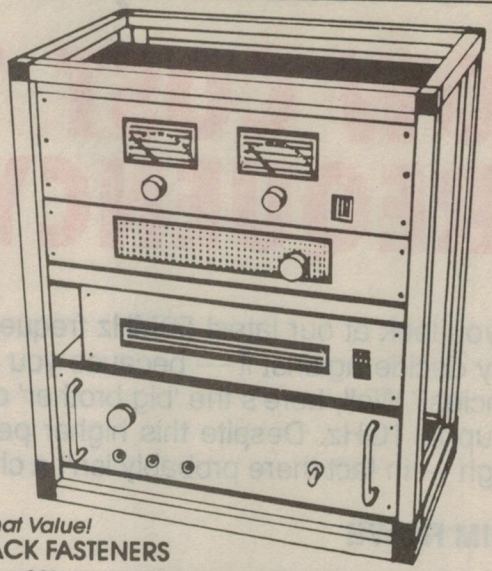
NSW: ARMIDALE: New England Electronics 711655 BALLINA: Ballina Electronics 867022 BATEMAN'S BAY: Baycity Sight & Sound 725030 BATHURST: Electronic Frontiers 323933 BOURKE: Countrywide Services 722150 BOWRAL: Bowral Electric Supplies 611861 BROKEN HILL: Hobbies & Electronics 884098 COOTAMUNDRA: Cootamundra Music & Lite 422561 COFFS HARBOUR: Coffs Harbour Electronics 525684 DENILIQUIN: Deni Electronics 813672 DUBBO: Chris's Hi Fi 828711 FORSTER Forster Village Electronics 545006 GOULBOURN: Tunlive 22 1288 GRAFTON: Repairs & Spares 421911 GRIFFITH: Miatronics 624534 INVERELL: Inverell Electronics 221821 KATOOMBA: Niagara Photo & Sports 822800 KEMPSEY: P&K Richards 63113 LEETON: Leeton Audiotronic 532800 LIGHTNING RIDGE: Lightning Ridge Solar Power 29 1013 LISMORE: Decro Electronic Services 214137 LITHGOW: Douroy Photographics 513173 MACKSVILLE: Macksville Electronics 682899 MOREE: Moree Electronics 522091 MUDGEE: Headware 723895 MURWILLUMBAH: Strings & Things 723684 NARRABRI: Namoi Computer Service 923274 NELSON BAY: Nelson Bay Elect & Hobbies 813685 NOWRA: Nowra Electronics 210722 PARKES: Strad Music C 623366 PORT MACQUARIE: Hastings Computer Service 840255 RICHMOND: Silicon Crafts 784101 TAREE: Manning Electronics 512233 ULLADULLA: Coastal Electronics 553989 WAGGA WAGGA: Phillips Electronics 216558 WALGETT: Walge Electronic Centre 281111 WINDSOR: Hawkesbury Electronics 776722 YASS: Warmington Electrical 261411 YOUNG: Keith Donges Electronics 821279 **VIC:** ARARAT: Jerram Electronics 522345 BAIRNSDALE: LH & LM Crawford 525677 BENALLA: Nort East Electronics 622710 CASTLEMAINE: Inspect Electrics 723773 COLAC: Colac Electronics 312847 ECHUCA: Gilmour Electronics 822956 MILDURA: Pullman Auto Pro 232882 MORWELL: Roytaine Pty Ltd 339458 ROSEBUD: Seatech Vic Pty L 822225 SHEPPARTON: Andrew Guyatt Electronics 219497 SWAN HILL: Nyah District TV Service 329303 ST. ARNAUD St. Arnaud Appliances 951069 WARRAGUL: Roytaine 234255 WARRNAMBOOL: Koroit St Elec Services 627417 WONTHAGGI: Sou Gippsland Photo Service 721411 **QLD:** AYR: Delta Electrix 831566 BLACKWATER: Cool Tronics 825827 BOWEN: Delpro Agencies 86 3477 BUNDABERG: Bob Elkin Electronics 521785 CALOUNDRA: Electro-mart 918533 DALBY: Hobby & Electronic 625770 EMERALD: Cooltronics 825222 GLADSTONE: Electronic Enterprises 726660 GOONDIWINDI: CTW Electronics 713411 INGHAM: Masons Electronics 763188 INNISFAIL: Innisfail Hi-Fi 612014 KINGAROY: MD & MM Siegle 624535 LONGREACH Longreach Sound & Communications 583307 MACKAY: Stevens Electronics 511723 MARYBOROUGH: Keller Electronics 214559 MOSSMAN: Mossman Electronics 982200 MT ISA: Outback Electronics 433331 NAMBOUR: Nambour Electronics 41196 PIALBA: Keller Electronics 283749 STANTHORPE Granite Belt Communications 813333 **TAS:** BURNIE: Electronic City 314760 DEVONPORT: Al Electronics 248322 **SA:** MT GAMBIER: Hutchesson's Communication 250400 PORT LINCOLN: Basshams T & Comp World 830075 WHYALLA: Eyre Electronics 454764 **WA:** ALBANY: Micro Electronics 412077 BUNBURY: Micro Electronics 216222 COWARAMUP: CPA Electronics 555448 GERALDTON: Direct Lighting 211278 KALGOORLIE: Today's Electronic 215212 MANDURAH: Mandurah Hi Fi 5812206 PORT HEDLAND: Ivan Tomek Electronics 732531

END OF LINE CLEARANCE!

30% OFF!

HURRY - LIMITED STOCKS!*

*(Please contact your local store regarding availability of stock)



A home for your equipment!

RACK FRAMES

Do your instruments have a place to go at night? We have 19" rack frames that are space efficient, cost effective, easy to assemble and an absolute bargain at 30% off the normal price! They'll keep your tools from wandering!

Size	Cat No.	Height	Price
6U	H-2380	358mm	**$104.30**
12U	H-2382	625mm	**$111.30**
18U	H-2384	893mm	**$118.30**
24U	H-2386	1158mm	**$132.30**
30U	H-2388	1425mm	**$153.30**
40U	H-2390	1870mm	**$188.30**

Added protection!

COVER SETS

For an incredibly low price you can turn your rack frame into a rack cabinet! It'll keep the dust out and provide your rack with additional strength.

No. Pieces	Cat. No	Price
3	H-2381	**$41.30**
3	H-2383	**$48.30**
3	H-2385	**$62.30**
5	H-2387	**$83.30**
5	H-2389	**$97.30**
5	H-2391	**$111.30**

Pretty Neat!

RACK CASES

High quality cases that fit neatly into your rack for space-efficient storage. Save space and save money - now you can have them for 30% off the normal price!

Size A x B x C	Finish	Cat.no	Price
44 x 34 x 38 (1U)	Black	H-2483	**$48.00**
88 x 57 x 82 (2U)	Black	H-2485	**$59.50**
132 x 89 x 126 (3U)	Black	H-2487	**$69.30**

Give Your Rack A Break!

BLANK PANELS

Bolt directly to your rack system to fill the spaces between your equipment, help keep out dust and give a neat finish.

Height	Finish	Cat.No	Price
44 mm	Black	H-2482	**$9.75**
88 mm	Black	H-2484	**$13.95**
132 mm	Black	H-2486	**$18.85**

What Value!

RACK FASTENERS

Save 30% on this 36 piece pack that includes matching screws, cage nuts and nylon washers.
Cat H-2393

$6.95

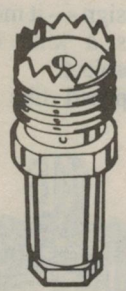
TRAY KIT *Save Big Bucks!*

Need somewhere to mount your non-standardised equipment? You can save over $10 on this tray that fits neatly onto your rack frame.
Cat H-2394

$27.95

Hard To Get!

IN-LINE UHF ('M' TYPE) SOCKET



In-line UHF socket for making communication cable extension leads mate with the commonly known PL259 series plugs.
Cat P-2320

$6.95

Switch On!

MINI SWITCH

A new square push-on/push-off switch with flat top. It is 11 x 12.5mm with a clearance depth of 32mm and an electrical rating of 240V AC.@ 1amp.

Black Cat P-7540 **$2.95**
Red Cat P-7542 **$2.95**

SPS420 STUD-MOUNTING DIODE

$12.95

New 400V 20A stud-mounted SCR with mounting hardware.
Cat Z-4314

DS XPRESS PHONE & MAILORDER SERVICE
Outside Sydney (FREE Call) 008 22 6610 Sydney And Enquiries - (02) 888 2105
FAX: (02) 805 1986 or write to DS XPRESS, PO BOX 321 N/RYDE NSW 2113
All Major Credit Cards Accepted. O/Nite Courier Available.

DICK SMITH ELECTRONICS

NSW • Albury **21 8399** • Bankstown Square **707 4888** • Blacktown **671 7722** • Brookvale **905 0441** • Bondi **387 1444** • Campbelltown **27 2199** • Chatswood Chase **411 1955** • Chullora **642 8922** • Gore Hill **439 5311** • Gosford **25 0235** • Hornsby **477 6633** • Hurstville **580 8622** • Kotara **56 2092** • Liverpool **600 9888** • Maitland **33 7866** • Miranda **525 2722** • Newcastle **61 1896** • North Ryde **878 3855** • North Sydney (Greenwood Plaza) **964 9467** • Orange **618 400** • Parramatta **689 2188** • Penrith **32 3400** • Railway Square **211 3777** • Sydney City **267 9111** • Tamworth **66 1711** • Wollongong **28 3800 ACT** • Belconnen **(06) 253 1785** • Fyshwick **280 4944 VIC** • Ballarat **31 5433** • Bendigo **43 0388** • Box Hill **890 0699** • Coburg **383 4455** • Dandenong **794 9377** • East Brighton **592 2366** • Essendon **379 7444** • Footscray **689 2055** • Frankston **783 9144** • Geelong **232 711** • Melbourne City 399 Elizabeth St **326 6088** & 246 Bourke St **639 0396** • Richmond **428 1614** • Ringwood **879 5338** • Springvale **547 0522 QLD** • Booval **282 6200** • Brisbane City **229 9377** • Buranda **391 6233** • Cairns **311 515** • Capalaba **245 2870** • Chermside **359 6255** • Maroochydore **791 800** • Rockhampton **27 9644** • Southport **32 9033** • Toowoomba **38 4300** • Townsville **72 5722** • Underwood **341 0844** • **SA** • Adelaide City **232 1200** • Beverley **347 1900** • Elizabeth **255 6099** • Enfield **260 6088** • St. Marys **277 8977 WA** • Cannington **451 8666** • Fremantle **335 9733** • Perth City **481 3261** • Midland **250 1460** • Northbridge **328 6944 TAS** • Hobart **31 0800** • Launceston **344 555 NT** • Darwin **81 1977 STORES ACROSS AUSTRALIA AND NEW ZEALAND**

B 1470

Construction Project:

LOW COST 1GHZ FREQUENCY COUNTER

Did you look at our latest 50MHz frequency counter design longingly (because of its low cost), but finally decide against it — because you need either more resolution and/or operation at higher frequencies? Well, here's the 'big brother' of that design, offering seven digits of resolution and operation up to 1GHz. Despite this higher performance the emphasis is still on good value for money, though — in fact there probably isn't a cheaper way to get yourself a 1GHz frequency counter.

by JIM ROWE

Most of the project designs we present in the magazine arise from a conscious decision either to produce a new project capable of meeting a perceived need, or to update/replace an earlier successful but dated design. But this new 1GHz counter design is something of an exception; there was no initial plan to produce such a design — it more or less came into being, as a kind of 'by-product' of another project.

It happened like this. When I was working on the design of the new low cost 50MHz counter published in the February issue, I decided to adopt a two-board approach — with the timebase, input conditioning, prescaling, gating and other 'housekeeping' circuitry on a horizontal main board, and the four-digit counter/display section on a smaller vertical board at the front. Then, part-way through the project and after having done the bulk of the PCB design, I suddenly realised that this approach would make it possible to change the design into one with greater resolution, simply by substituting a different counter/display board having two counter chips and more LED displays.

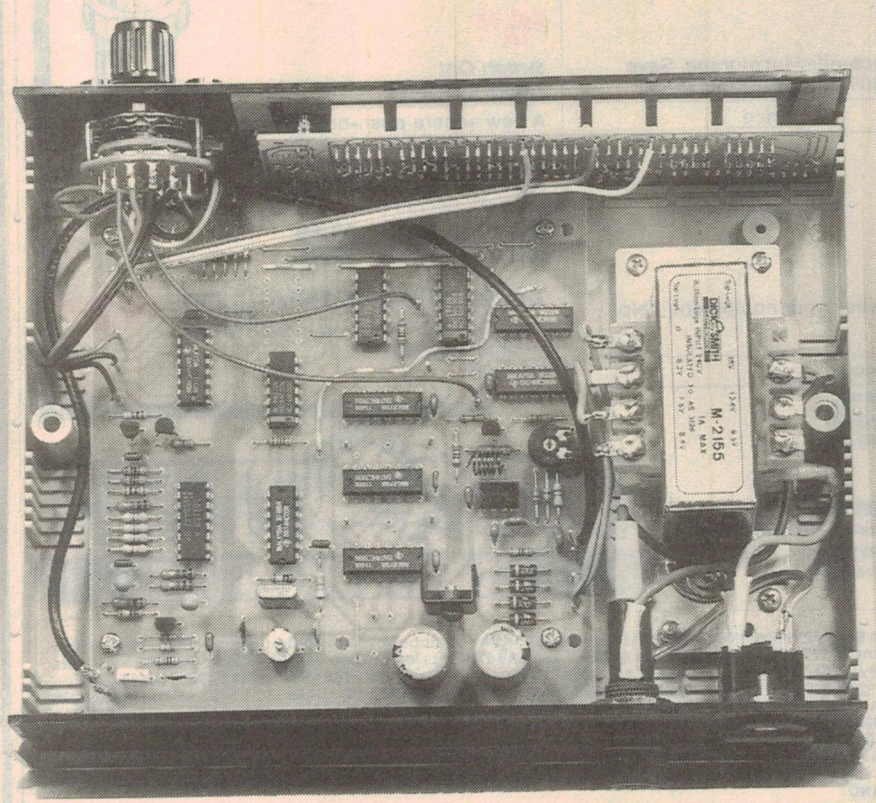
This suggested that I'd be able to produce a second design, with say seven or eight digits of resolution, for very little extra cost. It also made me stop and think: were there any *other* features that could conceivably also be added to the basic design relatively easily, and without jacking up the cost significantly?

The obvious choice was a further prescaler, to extend the upper frequency limit well beyond 50MHz — and ideally up to at least 1GHz or so. The challenge was to work out how such a prescaler could be added easily, and in a way that would still be in keeping with the basic concept of a 'useful but still budget priced' instrument design...

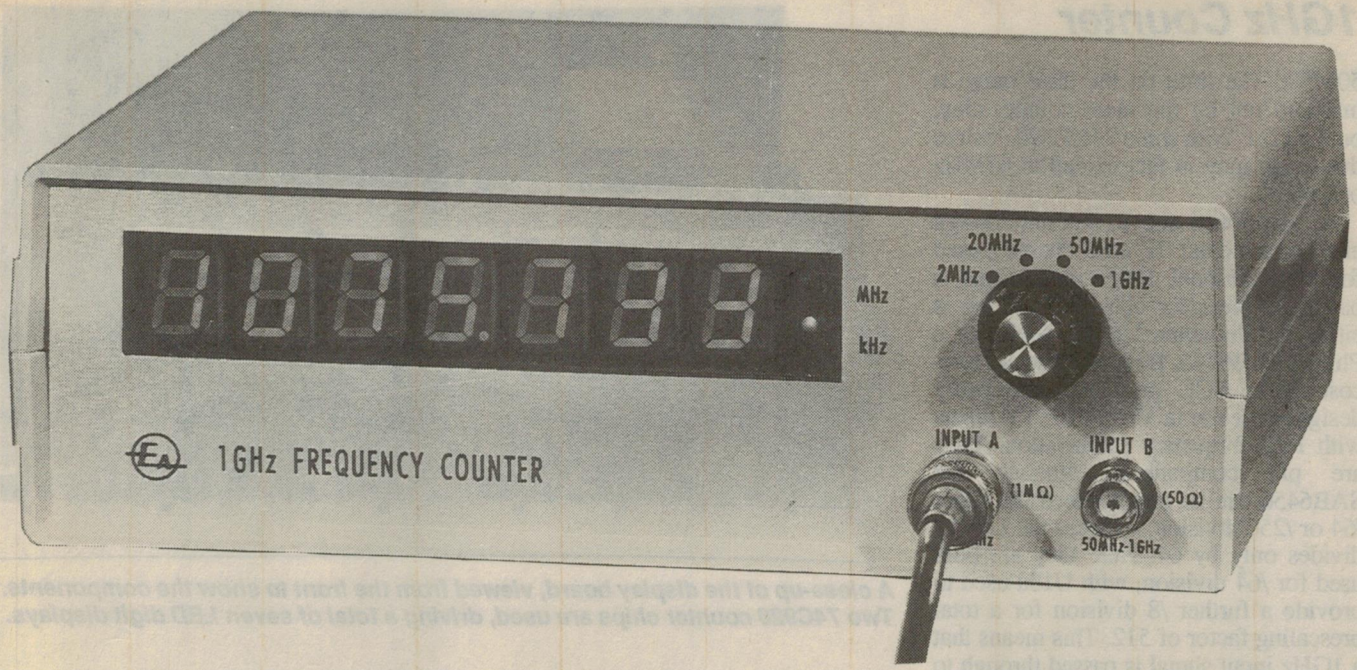
Happily there *are* a couple of low cost 1GHz prescaler chips currently available, both originally developed to use in PLL-stabilised TV tuners. A minor shortcoming is that they divide by a binary multiple (usually 64) rather than a decimal one, but I soon realised that this could be overcome with a corresponding adjustment to the timebase gating time.

The complication was that if such a low-cost prescaler was to be added easily later on, it would really have to be planned-in right from the start, and provision made on the main board for both the prescaler itself and the additional timebase logic circuitry. So it was back to the Protel *Autotrax* CAD package, to revamp the main board design.

This slowed up the development of the basic 50MHz counter, but I'm sure it was worth the effort. The end result is that we're now also able to provide this 'big



A general view inside the case of the new counter. Most of the components are mounted on two PC boards, the main one horizontal and the other vertical.



brother' counter design, which shares the same main PCB as the smaller version but uses it to provide both the prescaling and matched timebase circuitry for a new 1GHz range, in addition to the ranges of the smaller unit.

The other main feature of this new counter design is of course a different counter/display board, which uses a second counter chip in cascade with the single chip used in the first counter, to drive three additional displays and provide up to seven digits of resolution — more than sufficient for the vast majority of day-to-day frequency measurements.

And these additional features haven't involved very much increase at all in the basic cost of the design, compared with the basic 50MHz version. In fact I estimate that the cost of a kit for this 1GHz version should be around $165 — making it very likely the cheapest way yet to get yourself a 1GHz frequency counter.

So that's the story behind this new 'spinoff' design. It's certainly an accidental baby rather than one that was planned for, but now that it has come into the world, it's so attractive that it will hopefully meet with a warm reception.

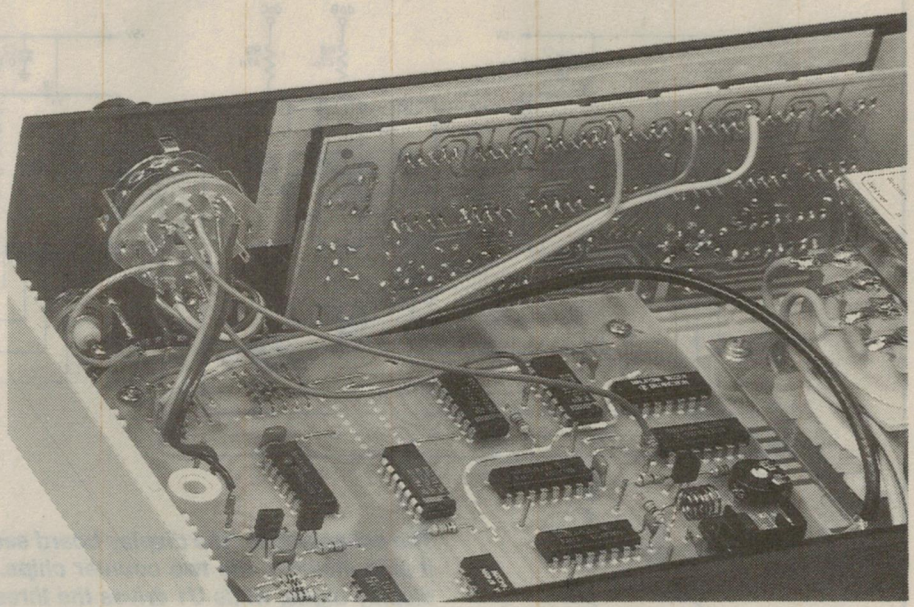
Circuit description

A great deal of the circuitry in the new design is identical to that in the 50MHz version, so I'm not proposing to provide a full description all over again; instead I'll just gloss over these sections at a fairly superficial level, and concentrate on the areas that are different. You'll find a more detailed description of the common sections in the first article, if you wish...

Like many other 1GHz counter designs, the new version has two different input signal channels: one of which, the 'A' channel, is virtually identical to that in the simpler version and is used for signals up to around 50MHz. The second 'B' channel is used for signals between 50MHz and 1GHz.

As described in the earlier article, the A channel uses JFET Q1 as an input source follower, to provide high input impedance. This is followed by U1, an ECL triple line receiver, used here to provide wideband gain and signal shaping. Transistors Q2 and Q3 are then used to provide an interface between the ECL chip and the following circuitry, which is based almost completely on 'HCMOS' devices. The first of these is U2, a 74HC390 double decade counter used for /10 and /100 prescaling of the A-channel signals. This prescaling is necessary as the main counter chip typically has a maximum counting frequency of between 2MHz and 4MHz at 25°C.

The first three positions of range switch SW1a are used to select either the direct, /10 or /100 versions of the channel A input signal, to provide nominal measurement ranges of 2MHz, 20MHz and



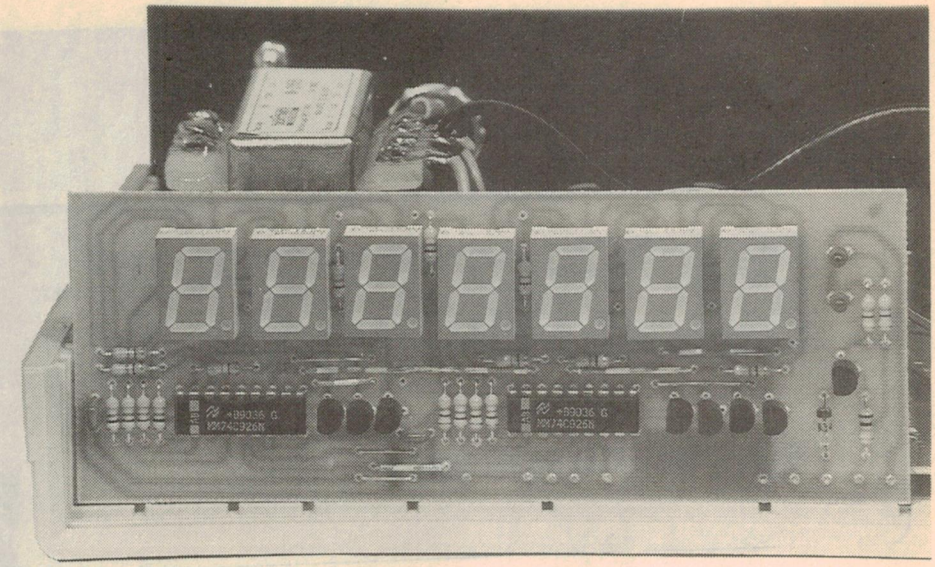
A closer view inside the case, looking from the rear. Visible are the front half of the main board and components, the range switch, the rear of the display board, the power transformer and much of the wiring to the range switch.

50MHz. The limit on the third range is imposed not by the main counter chip, but by U2a. With some 74HC390 devices this range may in fact extend to 65MHz or beyond.

As mentioned above, this new design also has a second 'B' input channel, used for the additional 1GHz range. This is based on prescaler chip U12, which is either a Telefunken U664B device or a Philips SAB6456. Both of these are low-cost 8-pin ECL prescalers, originally designed for use in VHF/UHF TV tuners with PLL frequency stabilisation. They are pin compatible, although the SAB6456 can be programmed for either /64 or /256 division, whereas the U664B divides only by 64. Here they are both used for /64 division, with U13a used to provide a further /8 division for a total prescaling factor of 512. This means that a 1GHz input signal is passed through to SW1a as only 1.953MHz — which is within the guaranteed capability of the main counting chip at all normal operating temperatures.

Like transistors Q2 and Q3 in the A channel, transistor Q4 is used to interface between the ECL logic level outputs of U12 and the HCMOS input of U13a. Preset pot RV1 is used to set the optimum operating point for Q4.

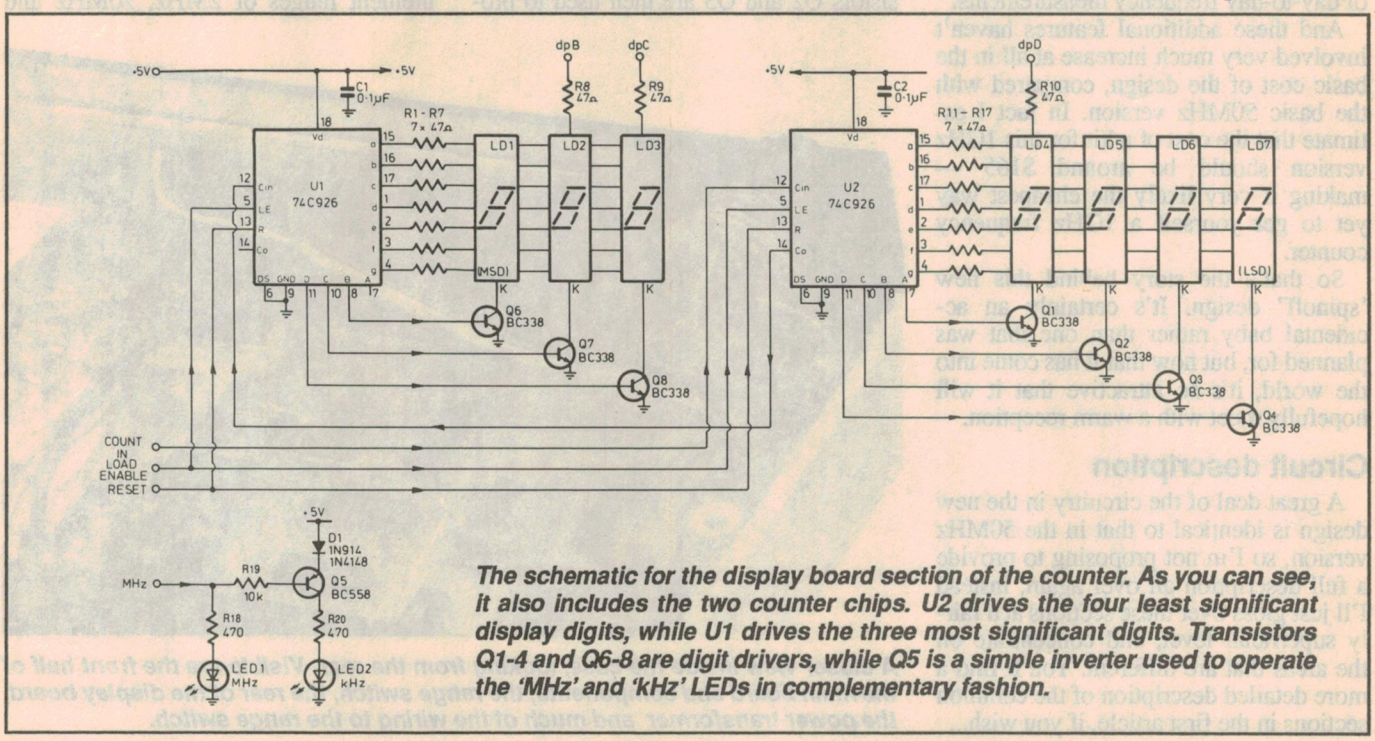
Both the U664B and the SAB6456 are rated to operate at up to 1GHz, with an input sensitivity of around 10mV and an input impedance of 50 ohms. In this circuit diodes D17 and D18 are used to provide protection against input overload, in conjunction with resistor R21. This reduces the input sensitivity a little at the top end, but not greatly. Resistor R20 is used to maintain the channel B input impedance at close to 50 ohms.



A close-up of the display board, viewed from the front to show the components. Two 74C926 counter chips are used, driving a total of seven LED digit displays.

The input signal selected by SW1a is fed to U8a, which is the counter's main gate. The gate is controlled by flipflop U7b, which together with U7a determines the counter's basic 'reset-count-load display' sequence. The timing of this sequence is set by feeding U7a and U7b with a signal derived from a crystal timebase oscillator, which uses 2MHz crystal X1 and gate U6a. Gates U8b and U8c are used to produce the counter's 'display load enable' and 'reset' control signals, from the outputs of U7a and U7b.

For the three measurement ranges using the channel A input signal, the timebase signal fed to U7a and U7b is a train of pulses with a period of 500ms — i.e., a frequency of 2Hz. These are derived from the 2MHz crystal frequency via cascaded decade dividers U3a, U3b, U4a, U4b, U5a and U5b, and fed to U7a via U6c and U10a. With these pulses fed to them, U7a and U7b produce a se-



The schematic for the display board section of the counter. As you can see, it also includes the two counter chips. U2 drives the four least significant display digits, while U1 drives the three most significant digits. Transistors Q1-4 and Q6-8 are digit drivers, while Q5 is a simple inverter used to operate the 'MHz' and 'kHz' LEDs in complementary fashion.

quence where the 'reset' and 'load display' phases are both 500ms long, and the count phase exactly one second. This also gives a counting sample rate of one reading every two seconds.

Needless to say the same timebase signal can't be used for the fourth measurement range, because the channel B signal is prescaled by a factor of 512 rather than unity, 10 or 100. So here a different train of timebase pulses is used, derived by cascaded dividers U13b and U14a from 1ms pulses taken from the main divider chain at pin 3 of U4b. U13b and U14a provide a division of /256, giving output pulses with a period of 256ms (3.90625Hz).

This alternative timebase pulse train is fed to U7a and U7b via U6b and U10a, when the 1GHz range is selected. As a result, the counter's timing sequence changes to give 'reset' and 'load display' phases 256ms long, and a count phase of exactly 512ms — to match the prescaling factor of input channel B, and give correct readings. For this range the counter gives one reading every 1.024 seconds — almost twice the sampling rate of the other ranges.

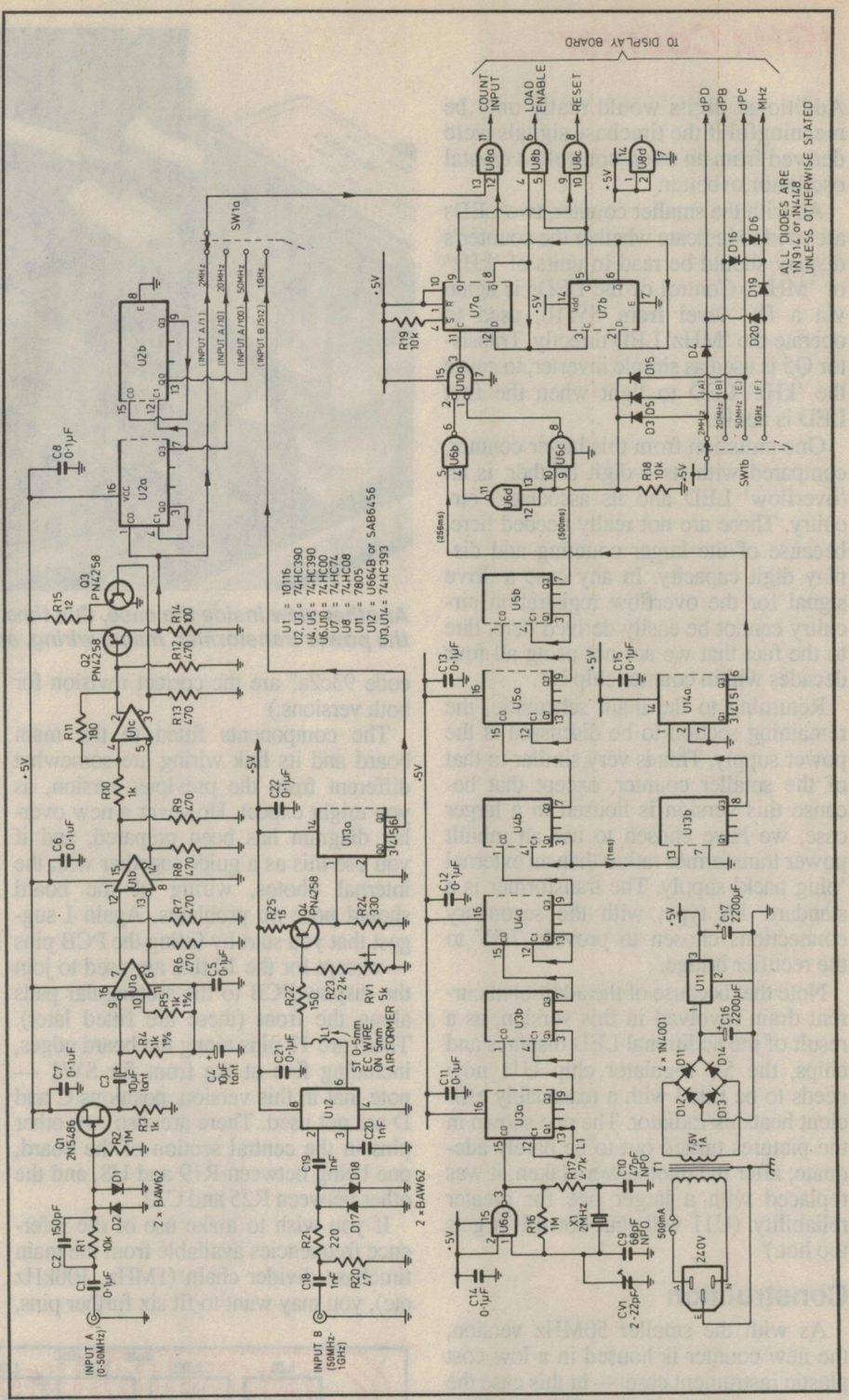
Selection of the two alternative timebase pulse trains is performed by SW1b, the second pole of the range switch, via diodes D3, D5 and D15 and also gate U6d (used as an inverter). Sw1b is also used to control the decimal point indication of the counter's display, via diodes D4 and D20 plus direct connections, and also the operation of the 'MHz/kHz' indicator LEDs, via diodes D6, D16 and D19.

As you can see from the smaller schematic, the counting and display section of the new counter is a little more complex than that of the smaller design, but it's still quite straightforward. The main difference is that there are now *two* of the 74C926 counter chips (U1 and U2), between them driving a total of seven 7-segment LED displays (LD1-7).

The counting signal gated by U8a (main schematic) is fed first to U2, which provides the first four decades of counting and display. The multiplexed outputs of this device are fed to the four least significant displays LD4-LD7, with transistors Q1-Q4 used to perform digit selection under the control of U2.

The carry output from U2 is then fed to the count unit of U1, which provides three further decades of counting and display. The multiplexed outputs of U1 are fed to the three most significant displays LD1-LD3, with transistors Q6-Q8 used for digit selection.

Why are we using U1 to drive only three additional digits, when like U2 it is obviously capable of driving four? Basically for reasons of economy and practicality. To take advantage of the additional resolution provided by the eighth digit, we would need to provide additional timebase gating times and signals. As well as adding to the circuit cost and complexity, this would also tend to give quite long measurement sample times. A further consideration is that because the timebase signals are derived from a simple on-board crystal oscillator, again for reasons of economy, the instrument's basic *accuracy* is inevitably limited to about one part in 100,000 (10^5). This means there is little point in providing more than about six or seven digits of resolution, at most.



The schematic for the rest of the counter, on the main PCB. Most of the circuitry has been used in earlier designs, and is well proven. U12 is the 1GHz prescaler.

Additional digits would really only be meaningful if the timebase signals were derived from an oven-controlled crystal oscillator, or better.

As with the smaller counter, two LEDs are used to indicate whether the counter's display should be read in units of 'kHz' or 'MHz'. Control of the LEDs is again via a DC level from SW1b, used to operate the 'MHz' LED directly. Transistor Q5 is used as simple inverter, to cause the 'kHz' LED to light when the first LED is not lit.

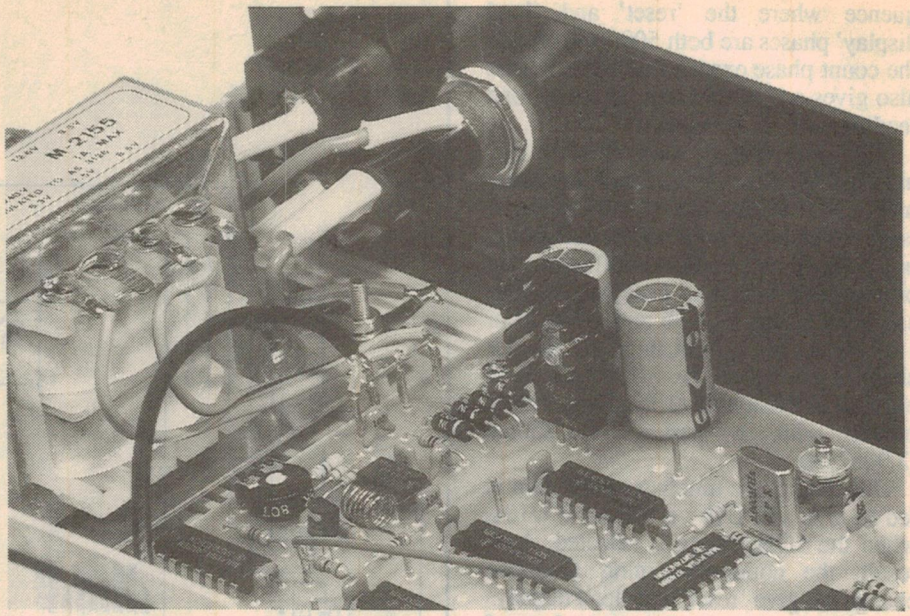
One omission from this larger counter, compared with its 4-digit brother, is an 'overflow' LED and its associated circuitry. These are not really needed here, because of the larger counting and display digit capacity. In any case a drive signal for the overflow registration circuitry cannot be easily derived here, due to the fact that we are not using all four decades within counter chip U1.

Returning to the main schematic, the remaining section to be discussed is the power supply. This is very similar to that of the smaller counter, except that because this version is housed in a larger case, we have chosen to use an inbuilt power transformer rather than an external 'plug pack' supply. The transformer is a standard 1A type, with the secondary connections chosen to provide 7.5V to the rectifier bridge.

Note that because of the additional current drain involved in this version, as a result of the additional LED displays and chips, the 5V regulator chip U11 now needs to be fitted with a reasonably efficient heatsink radiator. The one shown in the pictures turned out to be barely adequate; after the photos were taken, it was replaced with a larger one for greater reliability. (U11 will shut down if it gets too hot.)

Construction

As with the smaller 50MHz version, the new counter is housed in a low cost plastic instrument case — in this case the next size up, measuring 200 x 160 x 65mm (or 200 x 160 x 70mm — two slightly different versions are available, but either is suitable). As before there are two PCB boards, a main horizontal board measuring 120 x 129mm and coded 93c2a" and a smaller vertical display/counting board measuring 136 x 52mm and coded 93c3b. (Note that the main board is shared by both versions of the counter, but has been revised since the 4-digit design was published; hence the slightly different code. Boards with code 93c2a" are the correct revision for both versions.)



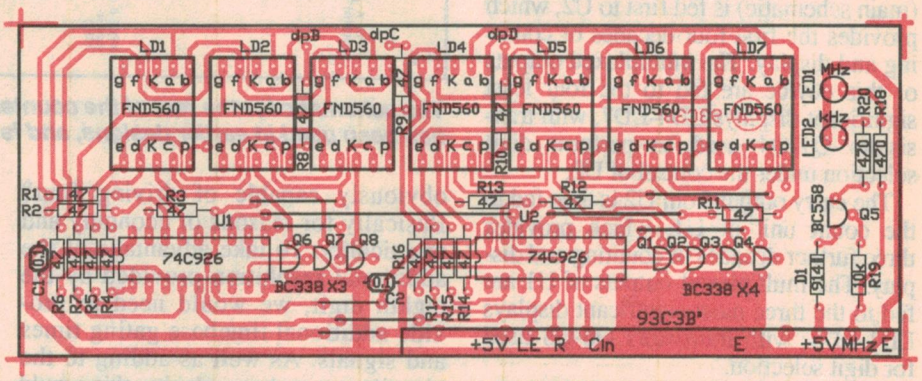
Another view inside the case, this time looking towards the rear so you can see the power transformer, mains wiring, and the rear section of the main board.

The components fitted to the main board and its link wiring are somewhat different from the previous version, as you might expect. However a new overlay diagram has been prepared, and if you use this as a guide together with the internal photos, wiring of the board should pose no problems. Again I suggest that you start by fitting the PCB pins — except for the 10 that are used to join the display PCB to the rectangular pads along the front (these are fitted later). There are 17 pins along the board edges, including five at the front for SW1 — note that in this version, positions C and D are not used. There are also two other pins in the central section of the board, one being between R19 and U8, and the other between R25 and C22.

If you wish to make use of the reference frequencies available from the main timebase divider chain (1MHz, 100kHz etc), you may want to fit six further pins, near U3-U5. These outputs could be used for calibrating receivers, scopes etc.

With the PCB pins fitted, it's a good idea to fit the various links before proceeding. Note there are 13 straight links (including two near D16, one near C10 and two near C22), plus a long link which runs from near C15 to between R18 and U4. Both the latter link and the longest of the straight links near the front of the PCB should be run in insulated hookup wire, while the rest can be in tinned copper wire or component pigtail offcuts.

Now you can start fitting the components to the PCB, beginning as usual with the low-profile resistors, smaller capacitors and diodes. Take care with the polarity of the diodes, and also with that of the tantalum capacitors C3 and C4. Make sure that you fit BAW62 diodes in the D1, D2, D17 and D18 positions, 1N4001 diodes in the positions marked D11-D14, and 1N4148 (or 1N914) diodes in the remaining positions.



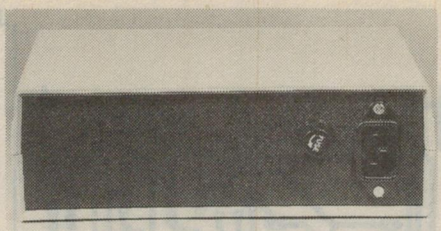
Here is the overlay diagram for the display PCB, to guide you in placing and orientating the components correctly. Note that there are also nine wire links.

At this stage you can fit trimmer capacitor CV1 and trimpot RV1, and the large electrolytic caps C16 and C17 — again ensuring they are fitted the correct way around.

You can also wind the small inductor L1, which consists of five turns of 0.5mm enamelled copper wire, wound on a 5mm drill shank or similar to give a self-supporting coil with an inner diameter of 5mm and a length of about 9mm. The inductor mounts on the board between R23 and U12, and up from it by about 2mm.

If you add crystal X1, this will complete the passive components on the main board. You can now fit the FET Q1, PNP bipolar transistors Q2-Q4, and finally the various IC's.

As usual take care with all of these regarding their correct orientation, and with the HCMOS devices (all except U1 and U12) take care also to avoid damage due to static charge. Earth yourself and your soldering iron, and preferably solder the supply pins of each device first, to allow the internal protection circuitry to operate as soon as possible.

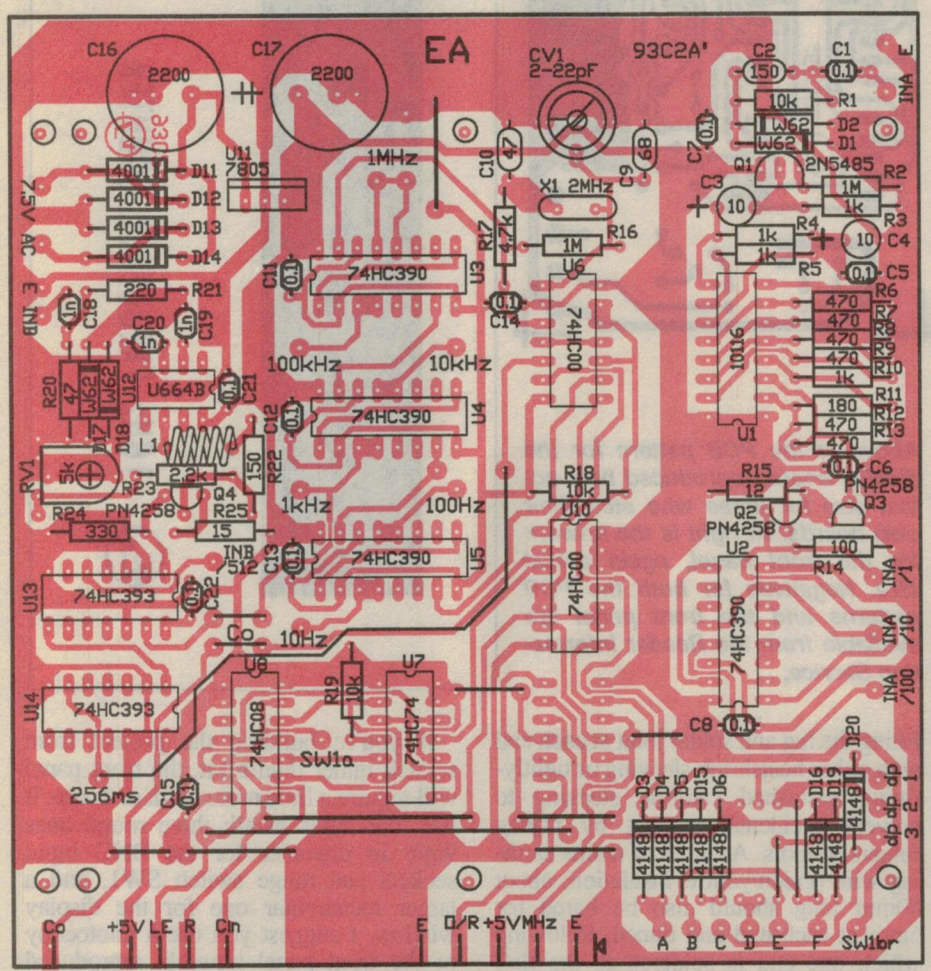


As you can see, the rear of the counter is very plain, with just a mains fuse and IEC captive input plug.

At this stage your main board should be complete, so it can be placed aside while you wire up the display board.

The display board has fewer components, and should take considerably less time. Again we have prepared an overlay diagram to guide you, along with the pictures.

Don't fit the PCB pins at this stage; they're best left until last. Begin with the links, of which there are nine. Most of them can be made in tinned copper wire, but the centre link in each group of three should ideally be made in insulated hookup wire to ensure that short-circuits can't easily occur.



And here's the overlay for the main PCB. Note that some sections of the board are wired differently from the 50MHz version — especially the area around U12.

Once the links are fitted you can add the resistors. Note that 17 of these are the same value (47 ohms), and three of this same group are mounted on the upper part of the board between the 7- segment displays. You may care to leave these three until the displays are fitted, to make sure they fit correctly. The two 470 ohm resistors and one 10k resistor mount at the right-hand end of the board.

With the resistors fitted you can now fit the two monolithic bypass caps C1 and C2, diode D1 and PNP transistor Q5 (BC558). Then fit the seven NPN transistors Q1-Q4 and Q6-Q8 (all BC338 or similar), making sure all transistors and diodes are orientated as shown in the overlay diagram.

Next, fit the seven 7-segment LED displays, making sure you fit each one so that its small round decimal point 'window' is towards the bottom of the PCB. Each display should be mounted right against the PCB surface, and it's worth taking a little care to ensure that they're all mounted squarely and in line.

When the displays are fitted you can fit the two single LEDs, orientating these so that their cathodes (shorter lead, 'flat' on plastic) are towards LD7. Again the LEDs should be mounted quite close to the PCB, so the tops of their bodies project no further than LD7 and the other displays.

The final step in wiring the display board is to fit U1 and U2. Again take care with their orientation, and as these are standard CMOS devices also take particular care to prevent damage from static electricity by earthing yourself and your soldering iron.

With the display board and main board now both completed, you can join them together using the remaining 10 PCB pins. I suggest you do this in the following way. First, push the pins through the holes along the lower edge of the display board, from the copper side and with their *shorter* ends passing into the holes. Don't solder them to the copper as yet, though. They should be a reasonably secure friction fit, if the holes for the PCB pins are the correct size.

Now invert the main board, and offer up to its front edge the copper side of the display board, also inverted but at 90°. The pins attached to the display board should line up with the rectangular pads on the front of the main board, if you've done everything correctly. It's then a matter of holding the two tightly together at 90°, and soldering the pins to the copper on both boards.

This is a little tricky, but not unduly difficult if you use the right approach. I tacked the two end-most pins to the main

PCB pads first, to hold everything together and allow me to check that the boards were at the correct 90° angle. Then I soldered the pins one by one to their display board pads, and finally soldered them to the main board pads.

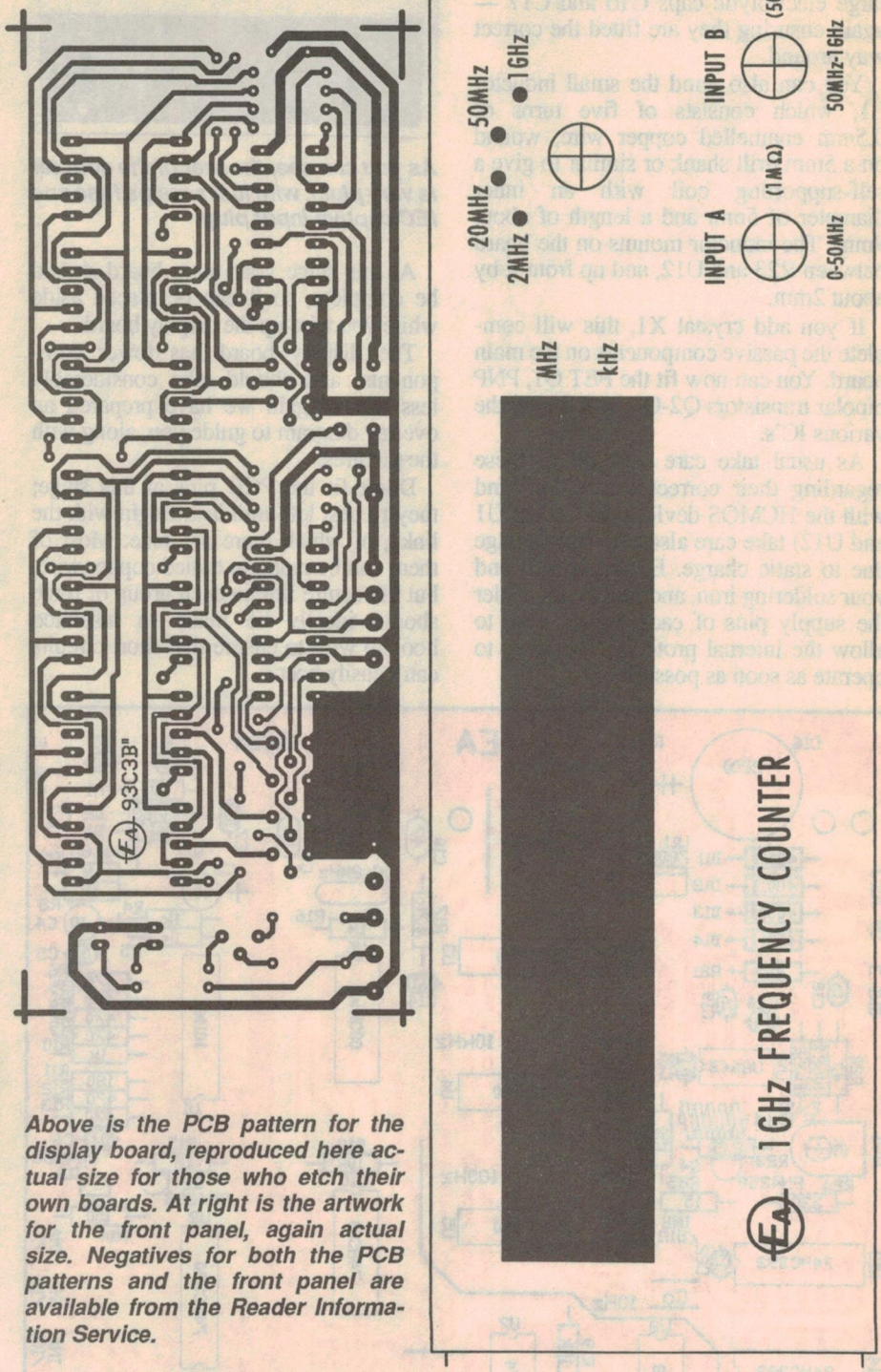
Just to make sure, I also ran a fillet of solder along the centre section, where the two 'earth' copper areas meet. This is more than enough bonding between the two boards, to provide adequate support for the display PCB when the main board is mounted in the case.

At this stage you might like to fit the three wires which make the only other connections between the two boards: those for the decimal point drive. These are made using three lengths of standard insulated hookup wire, or a three-conductor piece cut from 'rainbow' ribbon cable, about 150mm long. The connections are simple; the 'dpB' pad on the display PCB connects to the 'dp2' pin on the main PCB, 'dpC' to the 'dp1' pin and 'dpD' to the 'dp3' pin.

With the two boards now fully populated and assembled together, you can mount them into the lower half of the case. You'll find that the two 3mm holes on the right-hand side and the two innermost holes on the left-hand side of the main PCB line up with mounting pillar holes in the case, with the board assembly mounted almost as far as it will go towards the right and with the front surfaces of the vertical PCB's displays just behind the frontmost slot (to be occupied by the front panel). Four of the usual self-tapping screws can thus be used to fasten the board assembly in this position.

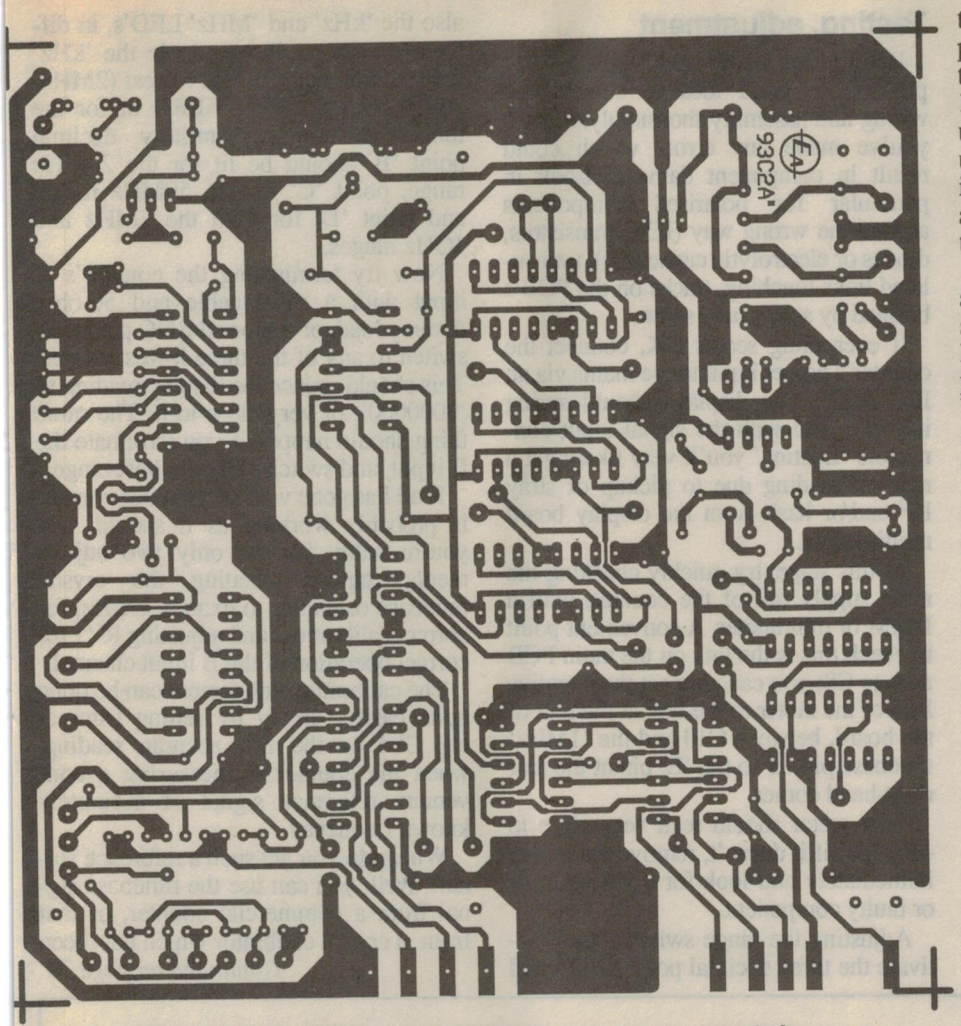
At this stage you can turn your attention to preparing the front and rear panels. The rear panel requires both a 12.5mm round hole to accept the mains fuse holder, and a rectangular hole 27 x 20mm for the IEC captive mains plug. Two 3mm holes are also required above and below the IEC plug hole, on its long axis and 40mm apart, for the plug mounting screws. Both the plug and the fuse holder should be located near one end of the rear panel, as shown in the photos, so they clear the main PCB components and end up near the power transformer.

When the holes are all finished, the plug and socket can be fitted to the rear panel. Use star lockwashers under the nuts for the plug mounting screws, to ensure that the plug cannot work loose. Now cut a 70mm length of mains-insulated wire with *brown* insulation, and use it to connect the *active* lug of the IEC plug to the END lug of the fuse holder — fitting the lug and solder joint at each end with either heatshrink sleeving or tightly-fitting varnished cambric sleeving to prevent accidental contact by prying fingers or tools. A length of mains earthing wire (green/yellow insulation) about 80mm long should also be bared for 5mm at each end and tinned, following which one end is soldered to the IEC plug's earth lug. This completes the rear panel assembly, at this stage.



Above is the PCB pattern for the display board, reproduced here actual size for those who etch their own boards. At right is the artwork for the front panel, again actual size. Negatives for both the PCB patterns and the front panel are available from the Reader Information Service.

If you're building the project from scratch rather than a kit, the front panel will require a little more work and care. It has four holes in all: three round ones 9mm in diameter for the BNC input sockets and range switch SW1, and a larger rectangular one for the display window. I suggest you use a photocopy of the front panel artwork, reproduced here, as a template to guide you in locating and cutting these holes. Obviously



Here's the revised pattern for the main PCB, again shown actual size.

it's worth taking care with the main rectangular hole in particular, because any crookedness or roughness will be very obvious in the final instrument.

To make the prototype unit look reasonably professional, we prepared a stick-on escutcheon from the artwork, using Dynamark photo-sensitive aluminium sheet (formerly Scotchcal). You may wish to do the same, or perhaps use a photographic print (bromide) glued to the front panel instead.

Either way, it would also be a good idea to attach a small piece of red or orange plastic sheet behind the display window, to act as a filter and improve the display's readability. The filter also tends to hide the minor components on the display board, around the LEDs and displays. I attached the plastic behind the front panel using masking tape, but you could probably use a few drops of cyanoacrylate 'super glue' for a more permanent job, if you're careful.

The input BNC connectors and range switch can now be mounted to the front panel, after you've cut the switch shaft to length and filed off any burrs. Then fit the control knob, and your front panel assembly is complete.

The next step is to prepare the sheet aluminium mounting plate for the power transformer. This should be cut from 1mm aluminium sheet, and measure 100 x 40mm. It has two holes on the longer central axis to mount the transformer, and four near the corners to mount the plate itself in the case. A seventh hole is used near one end to take the solder lug used to earth both the plate and transformer core/frame. The exact locations of both the transformer and plate mounting screw holes are best measured from your particular transformer and case, as both tend to vary. Similarly the location of the earth lug mounting hole is not critical.

When the plate is cut and drilled, mount the transformer in the centre using two 3mm diameter machine screws 10mm long, passing these up through the plate from below and fitting flat washers, star lockwashers and nuts over the transformer mounting lugs. The nuts should be well tightened, to ensure that the transformer is securely fastened to the plate. Then a solder lug should be fitted to the end of the plate, again using a 10mm-long 3mm machine screw passed up from below, with a star lockwasher under the solder lug so that when the nut is tightened, it bites into both the plate and the lug to bond the two reliably together.

The transformer plate assembly is now almost finished. All that remains is to solder a 100mm length of mains-insulated wire to each of the transformer's primary winding connection lugs, at the bottom of the bobbin assembly. One should have brown insulation, and the other blue. Both connections and lugs should then again be fitted with either heat-shrink or tight fitting varnished cambric sleeving, to prevent accidents.

The complete transformer plate assembly can then be mounted into the bottom of the case, alongside the PCB assembly, using four small self-tapping screws. The rear panel can also be slotted into position at the rear, and the last mains connections made. The loose end of the earth wire is soldered securely to the solder lug, the end of the blue wire from the transformer primary is soldered to the neutral lug of the IEC plug, and the end of the brown lead to the SIDE lug of the fuse holder. Both of these last joints should be fitted with insulating sleeving as before.

The final connections associated with the transformer are these between the '0' and '7.5V' secondary lugs and the AC input pins on the main PCB, made using two 80mm lengths of reasonably heavy insulated hookup wire.

The remaining phase is to fit the interconnections between the PCB assembly and the front panel control/connectors. There are only a very small number of these, and they're easily made with the front panel lying flat and 'face down' outwards from its final position.

The connections between the two BNC input connectors and the main PCB are both made using light duty 50-ohm coaxial cable. That for the 'INPUT A' connector is about 150mm long and connects to the 'INA' and 'E' pins near capacitor C1 at the right rear of the board, while the cable from the 'INPUT B' connector is about 190mm long and connects to the 'INB' and 'E' pins near the left rear of the board, just to the front of the AC input pins.

In both cases the inner conductor of the cable connects from the connector's centre lug to the PCB's live input pin, while the cable braid is used to connect the connector's earth lug to the respective PCB 'E' pin.

The remaining connections are those for the range switch SW1, and are made in standard insulated hookup wire.

Those for the SW1b side of the switch are very straightforward, with the pin marked 'SW1br' on the front of the main PCB connecting to the rotor lug, and adjacent pins A, B, E and F connecting to the lugs for the ranges in ascending frequency order and clockwise rotation sequence. So pin 'A' connects to the '2MHz' switch lug, pin 'B' to the '20MHz' lug and so on. Note that PCB pins 'C' and 'D' are not used in this version, only the 50MHz version.

The connections for the SW1a side of the switch are almost as easy. The rotor lug connects over to the pin on the main PCB between U8 and U7, marked 'SW1a'. Then three other wires are used to connect the 'INA/1', 'INA/10' and 'INA/100' pins on the PCB (near R14) to the switch lugs for the 2MHz, 20MHz and 50MHz ranges respectively. Finally, a 120mm length of insulated wire is used to link the 1GHz switch lug to the 'INB/512' pin on the main PCB, over near C22.

And that's all there is to the counter wiring. The front and rear panels can be swung up and slotted into position, and your counter should be ready for testing.

Testing, adjustment

Before applying any power, it's probably a good idea to check your wiring and assembly thoroughly, in case you've made any errors which could result in component damage. Look in particular for polarised components around the wrong way (IC's, transistors, diodes or electrolytic capacitors), uninsulated links touching, tracks on the PCB's bridged by solder, and so on.

If everything seems OK, connect the counter's power input to the mains via an IEC cable. The displays should spring into life, and with the signal input connectors 'floating' you'll very likely get a random reading due to pickup of stray RF and/or hash from the display board multiplexers.

At this stage, try quickly checking the main supply rail of the counter, with a DMM or multimeter. A convenient point to check this is the link on the main PCB next to C8; you can connect the negative lead of the meter to the link at the rear of the board, between C10 and the '1MHz' timebase pin, or to the 'E' pin at the rear right-hand corner.

Your meter should read very close to +5V DC; if it doesn't, remove the power immediately and look for a wiring error or faulty component.

Adjusting the range switch should activate the three decimal point LED's and also the 'kHz' and 'MHz' LED's, in different positions. For example the 'kHz' LED should be lit for the lowest (2MHz) range, with the 'MHz' LED lit for the remaining ranges. Similarly decimal point 'B' should be lit for the 20MHz range, point 'C' for the 50MHz range, and point 'D' for both the 2MHz and 1GHz ranges.

Now try terminating the counter's A input with a short cable and 50-ohm dummy load, or a shorted BNC plug, and switch to any of the three lowest ranges. This should reduce the display reading to '0000000', or very close to it. The same thing should happen if you terminate the B input, and switch to the highest range.

If all has gone well so far, your counter is probably working as it should, and you're ready for the only two adjustments required: setting the crystal timebase oscillator to exactly 2MHz, for correct calibration, and adjusting RV1 for correct operation of the B input channel.

The calibration adjustment can be done quite easily, simply by setting trimmer cap CV1 for the most accurate reading, when the counter is measuring a convenient reference signal of accurately known frequency.

Where do you get such a reference signal? Well, you can use the timebase signal from a commercial counter, or that from a crystal calibrator which has been

Continued on page 76

PARTS LIST

Main board

Capacitors

C1	0.1uF 100V MKT polyethylene
C2	150pF ceramic
C3,4	10uF 16VW tantalum
C5-8,11-15,21,22	0.1uF monolithic ceramic
C9	68pF NPO ceramic
C10	47pF NPO ceramic
C16,17	2200uF 16VW electrolytic (RB)
C18-20	1nF monolithic ceramic
CV1	2-22pF trimmer, PCB mount

Resistors

(All 1/4W 5% unless specified)

R1,18,19	10k
R2,16	1M
R3,10	1k
R4,5	1k 1%
R6-9,12,13	470 ohms
R11	180 ohms
R14	100 ohms
R15	12 ohms
R17	4.7k
R20	47 ohms
R21	220 ohms
R22	150 ohms
R23	2.2k
R24	330 ohms
R25	15 ohms
RV1	5k linear trimpot, hor. mtg

Semiconductors

D1,2,17,18	BAW62 high speed diode
D3-6,15,16,19,20	1N4148 or similar silicon diode
D11-14	1N4001 or similar 1A diode
Q1	2N5485 or 2N5486 junction FET
Q2-4	PN4258 fast switching PNP
U1	10116 ECL triple line receiver
U2-5	74HC390 dual decade counter
U6,10	74HC00 quad NAND gate
U7	74HC74 dual D-type flipflop
U8	74HC08 quad AND gate
U11	7805 5V/1A regulator (TO-220)
U12	U664B or SAB6456 ECL prescaler
U13,14	74HC393 dual 4-bit counter

Miscellaneous

L1	5 turns of 0.5mm EC wire, 5mm dia.
X1	2.000MHz crystal, HC-49/U
PCB	PCB, 120 x 129mm, code 93C2a"
J1,2	BNC connectors, panel mounting
J3	IEC mains plug, panel mounting
SW1	2 pole 4-position rotary switch
Case	Plastic instrument case, 200 x 160 x 65mm (or 200 x 160 x 70mm)
T1	Transformer, 240V to 7.5V at 1A
F1	500mA 3AG cartridge fuse

Panel mounting fuseholder for 3AG fuses; 18 x PCB pins (or 24 if desired); hookup wire; two short lengths of 50-ohm coax; instrument knob; tinned copper wire for PCB links; 100 x 40mm piece of 18g aluminium sheet, for mounting transformer; four 10mm long x 3mm round head machine screws; two 10mm x 3mm countersink head machine screws; two 3mm flat washers; six 3mm machine nuts; six star lockwashers; one solder lug; varnished cambric or heatshrink sleeving for mains connections; small heatsink for U11; red filter material 35 x 130mm for display window; solder, etc.

Display PCB

Capacitors

C1,2	0.1uF monolithic ceramic

Resistors

(All 1/4W 5%)

R1-17	47 ohms
R18,20	470 ohms
R19	10k

Semiconductors

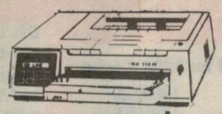
D1	1N914 or similar silicon diode
LD1-7	FND560 or similar 7-segment LED display
LED1,2	3mm LED, red
Q1-4,6-8	BC338 or similar NPN switching transistor
Q5	BC558 or similar PNP switching transistor
U1,2	74C926 CMOS quad decade counter/display driver

Miscellaneous

PCB PCB, 136 x 52mm, code 93C3b
10 x PCB pins; tinned copper wire and hookup wire for PCB links; solder, etc.

OKILASER 400

It's the cheapest it has ever been! The famous OKILASER 400 Laser printer at only $1249 Reliable and compact, it fits neatly into the smallest of offices. Highly reliable due to its latest LED imaging technology. The OL400 offers excellent print quality, superior paper handling, and a variety of fonts which rivals some of the more expensive laser printers on the market



5 year warranty on LED system head.

No moving parts (LED SYSTEM HEAD) recycles its own toner! Approx. 1.8 ¢ per copy.

Just $1,249.00

MONITOR HOLDER

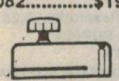
MONITOR MOVER ARM

Position your monitor exactly where yuo want int Maximize desk space.
- Solid steel structure
- Height Adjustment
- Span 33cm
- Maximum load 50kg

C21079.....$199.00

- Sturdy Steel construction
- Can rotate 360°
- Lifts monitors up to 22Kg.
- Locks in place with monitor on tray.

C21082.....$199.00



DISK NOTCHER

Converts 5 1/4" single sided floppy disks to double sided, by placing an appropriate notch in the floppy disk jacket.

C21070.....$7.95

KEYBOARDS

IBM COMPATIBLE EXTENDED KEYBOARD

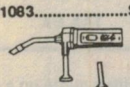
X12022.....$45.00

101 KEY TRACKBALL KEYBOARD Keyboard & Mouse in one

X12020.....$199.95

KEYBOARD STORAGE DRAWER

C21083.....$84.95



MINI VACUUM CLEANER

C21087.....$14.95

KEYBOARDS COVERS

C21089 84 KEY.....$4.50

C21088 101 KEY.....$5.95

MATH CO PROCESSOR

INTEL 387SX/SL$189

INTEL 386DX.....$199

DISK HOLDERS

3 /12" PLASTIC DISK HOLDER

- Holds 5 disks

Comes in 6 different colours

C16050 Red
C16054 Yellow
C16052 Orange
C16056 Green
C16058 Blue
C16060 Grey

Only .....$3.50 Each.

5 1/4" PLASTIC DISK HOLDER

- Holds 6 floppy disks

C16030.....$3.50

5 1/4" DISK STORAGE CASES

- Made of Sturdy black flexible plastic.
- Holds 10 or more 5 1/4" disks.
- Display positions

	1-9	10+	100+
C12020	$3.95	$3.50	$3.00

MEMOREX 3.5"Plastic disk holder

- Holds 10 Disks

C12840.....$3.95

3 1/2" DISK STORAGE

- 40 x 3 1/2" disk capacity
- High impact plastic lid & base

C16040.....$6.95

COPY HOLDERS

COPY HOLDER YU-H33

- Copy area 9 1/2" x 11"
- Sliding line glide
- Flat metal base

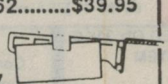
C21060.....$39.95

COPY HOLDER YU-H32

Adjustable arms allows easy positioning
- Copy area 9 1/2" x 11"
- Sliding line glide
- Clamping Mounting

C21062.....$39.95

GRIP CLIP COPY HOLDER



- Attaches to the top your monitor • Spring clip to hold paper • Velcro at mount for easy removal

C21065.....$14.95

NEW GENIUS SCANNER 4500

Black, White & Grey-Emulation scanner with powerful Photo/Image Editor & Multilingual Omnifont OCR.

Three grey emulation modes allows you to bring excellent reproductions of pictures into your reports, brochures, etc.Perfect for scanning line art. Scan objects in resolutions from 100 to 400 dpi.

GO-CR

This package includes the GO-CR Optical Character Recognition (OCR) program.

GO-CR scans text images into computer readable text files. The multilingual capabilities allows you to recognize documents in any one of 80 languages.

GO-CR is the supreme PC typist!

Edit, enhance and design professional-quality images with iPhoto Deluxe.

Combine images from several scans. It can even convert your black & white photos to true greyscale format. The ease of it's Windows based operation makes the power of this professional utility accessible to everyone.

.....$269.00

JAPANESE DRIVES

1.44MB 3.5" F.D.D $89.00

1.2MB 5.25"F.D.D $99.00

MICE

Z-NIX BUS MOUSE

Great for saving a serial port. 2 Free telepaint disks.Save $30 ONLY

X19951.....$89.00

QUICK MOUSE Microsoft compatible.

Free mouse house & mat plus free pop up software.

X19955 .....$59.95

NEW BUDGET MOUSE

Microsoft compatible steamline design an amazing

X19953.....$19.95

DR DOS 6.00

DOUBLE YOUR DISK STORAGE WITH NOVELL'S DR DOS 6.0

.....only $60.00

COMPUTER PAPER

Introducing ComPstat! High quality 70 gsm, convienienty packed continuous fan- fold computer paper.

Comes in packs of 250 or 500 sheets in two sizes. 279mm x 241mm and true A4. Very useful for photocopying computer print-outs without having white space on the top or bottom of the page.

279mm x 241mm
250 sheets
C21006.....$9.95
279mm x 241mm
500 sheets
C21007.....$16.95
True A4
296mm x 210mm
250 sheets
C21008.....$14.95
True A4
296mm x 210mm
500 sheets
C21009.....$19.95

MEMOREX RECYCLED COMPUTER PAPER 2000 SHEETS

C21002.....$29.95

BULK COMPUTER PAPER

Quality paper at a low price!
- 60 gms bond paper
- 11 x 9 1/2" 2000 sheets

C21001.....$39.95

- 15 x 11" 2000 Sheets

C21011.....$64.95

COPY PAPER FOR LASER PRINTER & PHOTOCOPIERS

A-4 Copy Paper 80GMS white recommended for high speed copiers/Laser printer. Also available in recyclcied paper

.....$7.95

DISK LABLES (To fit 3.5" disks) C21022 Qty. 25

.....$1.95

DISK LABELS & WRITE PROTECTS (To fit 5.25"disk) C21021 Qty. 25 labels & 25 write protects.....$1.95

DUST COVER

Keep your computer and accessories free of dust and grime while not in use.

XT* Cover Set
C21066.....$14.95
AT* Cover Set
C21068.....$16.95

HEAD CLEANER DISK

It takes only a minute amount of dust, dirt, or magnetic oxide particles on your drive heads to cause problems, errors downtime or expensive service call. Regular use of a head cleaner will keep your drive free of trouble causing dirt and help keep your system up and running. These disk cleaner are simple to use and include cleaning solution and instructions.
- 3 1/2" C12560.....$6.95
- 5 1/4" C12555.....$4.95

VIDEO BLASTER

The Video Blaster is the next logical step in multimedia. Just imagine being able to integrate video and audio source from laser disc, VCR, or camera, and combine VGA graphics into a brand new psychedelic world of multimedia presentations.

X17040..... $699.00

SOUND BLASTER with 16 ASP

FEATURES INCLUDE:
- True 16-bit stereo sound
- 4-operator, 20 voice stereo FM synthesis
- Improved stereo digital mixer
- Wave Blaster Upgrade Option
- CD-ROM interface
- Software Controls.

X17065.....$599.00

CD ROM Drive

features: • Includes sound blaster pro (short version) • CD quality sound (you can even play normal audio CD's) • Ability to display photographic images & motion version • Audio jacks for quality sound through your own speaker system •630 Mb of data on one compact disc • Full compliance with multimedia extensions 1.0 • Front mounted stereo headphone jack and volume control we now provide three different upgrade packages.

MULTIMEDIA UPGRADE KITS

Business pack includes: Sound Blaster Pro 2 Sound Card • Internal CD-Rom Drive •7CD.Titles

X17052.....$1299.00

Educational Pack Includes: Sound Blaster Pro2 Sound card • Internal ZCD Rom Drive • 7 CD Titles

X17060.....$1099.00

CD-Rom Upgrade kit CD-Rom Drive and cables • Complete with 7 C.D Titles • No sound blaster card

X17053.....$899.00

SOUND BLASTER DELUXE

The Sound Blaster Deluxe is the Ultimate sound card that easily plugs into any slot of your IBM, PC, XT, AT, 386, etc.

The Sound Blaster Deluxe has taken the spot of the Sound Blaster II. And now it has heaps more software like Creative Wavestudio, Creative Talk Scheduler,Creative Mosaic and comes with 2 FREE games! Lemmings and Indianaplois 500.

X17080.....$149.00

SOUND BLASTER PRO...$299

SOUND BLASTER PRO VERSION 2...$399

RITRON COMPUTER SYSTEMS

RITRON EXECUTIVE 386SX-41

80386SX 33M CPU
2 MEG RAM EXP TO 8 MEG
41Mhz LANDMARK SPEED TEST
1.2M JAP F.D.D. 512K VGA CARD
40M HARD DISK DRIVE,
101 EXTENDED "CLICK" KEYBOARD
MINI CASE & 200W POWER SUPPLY
SUPA VGA COLOUR MONITOR
1024 x 768 Res 0.28" D.P
SERIAL PARALLEL GAMES PORTS
4 YEAR PARTS & LABOUR
WARRANTY IBM* COMPATIBLE
SPREADSHEET, WORDPROCESSOR
& DATABASE SOFTWARE INCLUDED.
* SHAREWARE SOFTWARE
ASSEMBLED & TESTED IN AUSTRALIA

NOW WITH 2 MEG OF RAM!

$1,299 TAX INC.
$1059 TAX EX

RITRON EXECUTIVE 386-57

Add $25 for 128K Cache

80386-33 CPU
64K CACHE ON BOARD MEMORY
2 MEG RAM EXP TO 16 MEG
57Mhz LANDMARK SPEED TEST
40 MEG HARD DISK
1.2M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
SERIAL PARALLEL GAMES PORT
MINI CASE & 200W POWER SUPPLY
SUPA VGA COLOUR MONITOR (1024 x 768 Res) 0.28" DP
512K VGA CARD (256 COLOURS) IBM* COMPATIBLE
4 YEAR PARTS & LABOUR WARRANTY
SPEADSHEET, WORDPROCESSOR & DATABASE
SOFTWARE INCLUDED.
*SHAREWARE SOFTWARE
ASSEMBLED & TESTED IN AUSTRALIA.
Add $25 for 128K Cache

NOW WITH 2 MEG OF RAM!

$1,399 TAX inc
$1,165 TAX EX

OPTIONAL EXTRAS

ON TOP OF BASE SYSTEM PRICE.

DR DOS 6.0 ADD.....$70.00
MS DOS 5.0 ADD $90.00
MS DOS 5.0 & WINDOW 3.1....$179.00
1M VGA CARD $100.00
386-40 UPGRADABLE MOTHERBOARD..$100.
LOCAL BUS VESA GRAPHIC CARD
TO SUIT ABOVE MOTHERBOARD.....$450.00

TO CHANGE A 40M HARD DRIVE TO A
85M HD add $100
131M HD add $190 105M HD..$140
200m HD add $380 170M HD..$265
345M HD add $875 512M HD..$1275

EXTRA RAM
1M add $59 2M add $118 4M add $236

SOUND CARDS
SOUND COMMANDER FX..... $159
SOUNDBLASTER DELUXE With Speakers... $159
SOUNDBLASTER PRO..... $299
FLOPTICAL DRIVE add..... $649
21 M/BYTE DISC TO SUIT..... $49
CD ROM SOUND BLASTER PACK..... $999
PARRADISE WINDOW ACCELERATOR..... $275
CASES MINI TOWER.$50 FULL TOWER.$175

RITRON EXECUTIVE 386-65

80386-40 CPU 64K CACHE ON BOARD
4 MEG RAM EXP TO 16 MEG
65 Mhz LANDMARK SPEED TEST
40 MEG HARD DISK 12ms ACCESS TIME. 1.2M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
MINI CASE & 200W POWER SUPPLY SERIAL, PARALLEL, GAMES PORTS 512K VGA CARD, SUPA VGA COLOUR MONITOR
(1024 x 768 Res) 0.28" 4 YEAR PARTS & LABOUR WARRANTY SPEADSHEET, WORDPROCESSOR & DATABASE SOFTWARE INCLUDED. *SHAREWARE SOFTWARE

NOW WITH 4 MEG OF RAM!

$1,449 TAX INC.
$1,210 TAX EX.

WITH 200 MEG DRIVE
$1,849 TAX INC.
$1,549 TAX EX.

RITRON EXECUTIVE 486-89

80486SX-33 CPU 256K CACHE
4 MEG RAM EXP TO 32 MEG
75Mhz LANDMARK SPEED TEST
40 MEG HARD DISK
1.2M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
MINI CASE & 200W POWER SUPPLY
4 YEAR PARTS & LABOUR WARRANTY
SERIAL, PARALLEL, GAMES PORTS, 512K VGA CARD
SUPA VGA COLOUR MONITOR (1024 x 768 Res) 0.28" DP
SPEADSHEET, WORDPROCESSOR & DATABASE
SOFTWARE INCLUDED. *SHAREWARE SOFTWARE
ASSEMBLED & TESTED IN AUSTRALIA.

NOW WITH 4 MEG OF RAM!

$1,699 TAX INC.
$1,399 TAX EX.

WITH 200 MEG DRIVE
$2,079 TAX INC.
$1,750 TAX EX.

RITRON EXECUTIVE 486-157

80486-33 CPU
256K ON BOARD CACHE. 4 MEG QF RAM
157Mhz LANDMARK SPEED TEST
40 MEG HARD DISK
1.2M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
SERIAL, PARALLEL, GAMES PORTS
512K VGA CARD. IBM* COMPATIBLE
SVGA COLOUR MONITOR (1024 x 768 Resolution) 0.28"DP
MINI CASE & 200W POWER SUPPLY
4 YEAR PARTS & LABOUR WARRANTY
SPREADSHEET, WORDPROCESSOR & DATABASE SOFTWARE.

NOW WITH 4 MEG OF RAM!

$1,945 TAX INC.
$1,645 TAX EX.

WITH 200 MEG DRIVE
$2,345 TAX INC
$1,945 TAX EX

RITRON EXECUTIVE 486-157

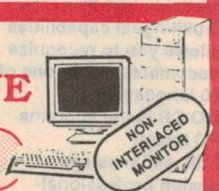
80486-33 CPU 256K ON BOARD CACHE. 4 MEG OF RAM
157Mhz LANDMARK SPEED TEST
200 MEG HARD DISK 5ms T.T ACCESS TIME. 1.2M JAPANESE BRAND F.D.D
3.5" 1.44M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
SERIAL, PARALLEL, GAMES PORTS
1 MEG VGA CARD. IBM* COMPATIBLE
TOWER CASE & 220W POWER SUPPLY
NON-INTERLACED SUPA VGA COLOUR MONITOR
(1024 x 768 Res) 0.28" DP
4 YEAR PARTS & LABOUR WARRANTY
SPEADSHEET, WORDPROCESSOR & DATABASE SOFTWARE.
ASSEMBLED & TESTED IN AUSTRALIA.

200M HARD DRIVE & TOWER

4 MEG RAM

$2,949 TAX INC.
$2,499 TAX INC.

RITRON EXECUTIVE 486-200+



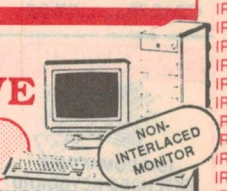
80486DX2-50 CPU 256K ON BOARD CACHE. 4 MEG RAM
200+Mhz LANDMARK SPEED TEST
200 MEG HARD DISK 5ms T.T ACCESS TIME. 1.2M JAPANESE BRAND F.D.D
3.5" 1.44M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
SERIAL, PARALLEL, GAMES PORTS
1 MEG VGA CARD. IBM* COMPATIBLE
TOWER CASE & 220W POWER SUPPLY
NON-INTERLACED SUPA VGA COLOUR MONITOR
(1024 x 768 Res) 0.28" DP 4 YEAR PARTS & LABOUR WARRANTY. SPEADSHEET, WORDPROCESSOR & DATABASE SOFTWARE.
ASSEMBLED & TESTED IN AUSTRALIA.
IDEAL CAD MACHINE!
Add $300 for DX66

200M HARD DRIVE & TOWER CASE

$3145 TAX INC.
$2675 TAX EX.

4 MEG RAM

RITRON EXECUTIVE 486-EISA



80486-33 EISA CPU 256K ON BOARD CACHE.
4 MEG OF RAM
167 Mhz LANDMARK SPEED TEST
200 MEG HARD DISK 5ms T.T ACCESS TIME 1.2M JAPANESE BRAND F.D.D
3.5" 1.44M JAPANESE BRAND F.D.D
101 EXTENDED "CLICK" KEYBOARD
SERIAL, PARALLEL, GAMES PORTS
1 MEG VGA CARD. IBM* COMPATIBLE
TOWER CASE & 220W POWER SUPPLY
NON-INTERLACED SUPA VGA COLOUR MONITOR
(1024 x 768 Res) 0.28" DP
4 YEAR PARTS & LABOUR WARRANTY
SPEADSHEET, WORDPROCESSOR & DATABASE SOFTWARE.
80486-50 EISA extra $200
80480-50 EISA extra $360

200M HARD DRIVE & TOWER CASE

4 MEG RAM

$3895 TAX INC.
$3200 TAX EX

ROD IRVING ELECTRONICS Est:1977

MAIL ORDER HOTLINE: 008 33 57 57. ORDER FAX LINE: (03) 543 4871 ENQUIRES (03) 543 7877
HEAD OFFICE: 56 RENVER RD, CLAYTON. PH: (03) 543 2166. FAX (03) 543 2648
MELBOURNE: 48 A'BECKETT ST. MELBOURNE. PH. (03) 639 1640. FAX: 639 1641.
OAKLEIGH: 240C HUNTINGDALE RD, OAKLEIGH. PH: (03) 562 8939 FAX: (03) 562 8940
NORTHCOTE 425 HIGH ST. NORTHCOTE, PH. 489 8866. FAX: 489 8131.
SYDNEY:74 PARRAMATTA RD, STANMORE. PH: (02) 519 3134. FAX: (02) 516 5024.
NEW STORE - ADELAIDE: 241-243 WRIGHT ST, ADELAIDE. PH:(08) 211 7200 FAX: (08) 211 7273
BLUESTAR COMPUTERS:
MELBOURNE: 271 MAROONDAH HWY, RINGWOOD, PHONE: (03) 870 1800 FAX: (03) 879 3027
SYDNEY: 115 - 117 PARRAMATTA RD CONCORD. PH: (02) 744 5526 FAX: (02) 744 5405.

FREIGHT CHARGE BASED ON 35KG COMPUTER SYSTEM

Melb-Metro.$12.00	Vic country....$19.00
Sydney..... $17.00	NSW country.$39.00
Adelaide.....$17.00	S.A country...$39.00
Bribane..... $24.00	QLD country.$55.00
Canberra.... $18.00	W.A country..$74.00
Darwin..... $40.00	Insurance:-
Perth.....$31.00	$1 / $100 Value.
Tasmania....$53.00	

OUR POLICY.

Come to us with a written quote on a computer system and we will beat that price. WE WON'T BE UNDERSOLD!*
*Conditions Apply.
Tax ex. Orders: Ritronics Wholesale:
Ph:(03) 543 2166. Fax: (03) 562 7734

RIE BULLETIN BOARD: (03) 562 7903
For Specials, Service & information.

SCHOOL, GOVERNMENT DEPARTMENTS, SMALL BUSINESS, TAKE NOTE.
QUANITY DISCOUNTS AVAILABLE CONTACT RITRONIC WHOLESALE: (03)543 2166

5.25" from 39¢ CHEAP BULK DISK PRICES! 3.5" from 62¢

NO BRAND DISKS

ALL DISKS INCLUDE WRITE PROTECTS & ENVELOPES
BOXES OF TEN DISKS LIFETIME WARRANTY

	1-9+	10+	50+	100+	500+
5 1/4" DS/DD	$4.75	$4.60	$4.40	$4.20	$3.95
5 1/4" DS/HD	$8.50	$8.25	$8.10	$7.95	$7.50
3 1/2" DS/DD	$8.50	$8.25	$8.10	$7.95	$7.50
3 1/2" DS/HD	$13.95	$13.50	$12.50	$11.95	$10.95

MEMOREX DISKS

	1-9 boxes	10+
3 1/2"DD	$19.95	$18.95
3 1/2"HD	$45.95	$42.95
5 1/4"DD	$14.95	$12.95
5 1/4"HD	$23.95	$22.95

VERBATIM DATALIFE

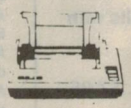
	1-9 boxes	10+
3 1/2"DD	$21.95	$20.95
3 1/2"HD	$42.95	$41.00
5 1/4"DD	$17.95	$16.95
5 1/4"HD	$22.95	$21.95

VERBATIM VALUELIFE

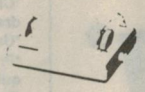
	1-9 boxes	10+
3 1/2"DD	$19.95	$18.95
3 1/2"HD	$34.95	$32.95
5 1/4"DD	$10.95	$9.95
5 1/4"HD	$15.95	$14.95

YOU'LL HAVE TO GO A LONG WAY TO FIND DISK PRICES LIKE THESE

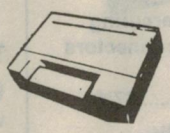
SAVE ON OUR GREAT RANGE OF EPSON PRINTER



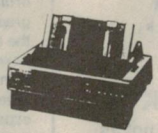
LX-400 80 Col, 9 Pin Dot Matrix, 180 Cps Draft 30 Cps NLQ, Pull Tractor
C22054..... $245



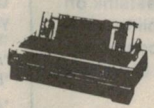
LX-850 80 Col, 9 Pin Dot Matrix, 240 Cps Draft 48 Cps NLQ, Push Tractor, Smart Park Feature
C22074..... $375



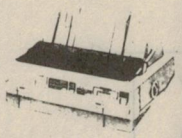
LQ-100 80 Col, 24 Pin Dot Matrix 200 Cps Draft, 72 LQ, Built in sheet, feeder 8 fonts. 2 scalable fonts
C22070..... $399



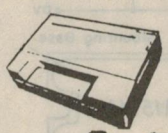
LQ-870 80 Col, 24 Pin Dot Matrix,330 Cps Draft, 110 Cps NLQ, Scalable Fonts, 8 to 32 points, 11LQ Fonts , 360 x 360 DPI, Top, Rear, Bottom, & Front paper Feed paths Convertable Push/Pull Tractor.
C22072..... $950



LQ-1070 136 Col, 24 Pin Dot Matrix, 252 Cps Draft., 84 Cps NLQ, Scalable Fonts, 8 to 32 point, 11 LQ Fonts, 360 x 360 DPI, Top, Rear, Bottom, and Front Paper Feedpaths, Convertable Push/Pull Tractor
C22066..... $770



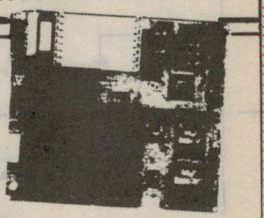
LQ-570 80 Col, 24 Pin Dot Matrix, 252 Cps Draft, 84 Cps, NLQ Scalable Fonts 8 to 32 points, 11 LQ Fonts 360 x 360 DPI, Top, Rear, Bottom and Front paper feed paths, Convertable Push/Pull Tractor.
C22068..... $549



LX-100 80 Col, 9 pin Dot Matrix, 240cps Draft, 48 cps NLQ, 3 fonts, 50 sheet paper cassette Standard Push Tractor with SmartPark.
.....$399

EPSON LASER EPL-4000

Combines a semiconductor laser with electrophotographic technology to give you high quality printing that is both fast and quiet. The EPL-4000 can compose an entire page in its internal memory before printing. It has the ability to mix text graphics, create pre defined forms and print with a range of fonts normally associated with typesetters.....$1495.00



386/486 MULTIBOARD WITH 386-40 PROCESSOR FITTED

The OPTI-495SX 3/486WB Cache motherboard is a low cost 3 chip solution offering optimal performance for low to Mid range 386/486 Cache base AT sysytem. The OPTI-495SX 3/486WB Cache M/B is designed for 386 systems running from 25 33 and 50MHz It supports 386DX, 486SX, 486DX 486DX2 and one 32 Bit local Bus.
The OPTI-495SX 3/486WB Cache motherboard also has an option to accomodate either 64K, 128K, 256K, of external Cache and support the 80387 numerical Co-processor. Because of it's unique memory subsystem design, the OPTI-495SX 3/486WB Cache M/B allows for 1 Megabyte to 32 Megabytes of 32-bit high speed memory by using 256K, 1M amd 4M SIMM modules.
Cat No.
X18117.....$499.00

Rod Irving Electronics now provides a motherboard that works around the pinout problems with jumpers that allow you to start off with a bare motherboard and install whatever CPU you wish to use (386 or 486). So therfore just by changing your CPU at a later date you can upgrade your system.

Local Bus VESA 1 MEG VGA card to suit above multiboard....$499.00

IBM CARDS

NEW LOCAL BUS VESA CARD for HIGH SPEED GRAPHICS	$499
PRINTER CARD	$29
6M RAM CARD	$249
2 PORT SERIAL CARD	$39
GAMES CARD	$29
CLOCK CARD	$39
512/576K RAM CARD OK RAM	$69
2 WAY FDD CONT.	$89
4 WAY FDD CONT	$129
VGA 16 BIT 256K	$59
VGA 16 BIT 512K	$79
VGA 16 BIT 1 MEG	$149
16M HD CACHE CARD OK RAM	$495
HDD IDE /FDD 24MHz	$29
HDD IDE/FDD/SPG	$39
8 BIT ETHERNET CARD	$235
16 BIT ETHERNET CARD	$285
AT HD CONTROLLER	$149
MULTI I/O CARD	$99
MONO COLOUR CARD	$69
EGA CARD	$99
DIAGNOSTIC CARD	$795
TTL PRINTER CARD	$79
FAX CARD	$595
6M AT EX/EXP	$225
PARADISE ACCELERATOR	$275
PARKEET ACCELERATOR	$269

HARD DRIVE SPECIALS

PRICES ARE WITHOUT PADDLE CARDS & BRACKETS
2 YEAR WARRANTY ON VOICE COILS

40M SEAGATE DRIVE	$299
85M HD 6ms T.T ACCESS. VOICE COIL	$369
105M HD 6ms T.T ACCESS	$429
126M HD 6ms T.T ACCESS. VOICE COIL	$449
170M 6ms T.T ACCESS	$539
212M HD 5ms T.T ACCESS. VOICE COIL	$599
340M H.D 5ms T.T ACCESS	$1195
412M H.D 5ms	$1595
528M HD 5ms T.T ACCESS	$2295

MEMORY

MEMORY	1-9	10-99	100 +
41256-08	$2.95	$2.75	$2.50
44256-07	$7.75	$7.50	$6.50

SIMMS	1-9	10-24	25+	100+
256K-60	$29	$27	$26	$25
256K-70	$23	$21	$19	$17
256K-80	$21	$19	$17	$15
1M x 9-70	$59	$57	$55	$54
1M x 9-60	$62	$60	$59	$57
4M x 9-70	$269	$259	$249	$229
4M x 9-60	$369	$359	$349	$3290

SIPPS				
1M x 9-80	$99	$95	$89	$85
256K-60	$29	$27	$26	$25

MOTHERBOARDS

386SX-33/41	$195.00
386-33 64K CACHE	$399.00
386-40 128K CACHE	$369.00
486SX-33 256K Cache	$699.00
386-40 128 Cache with Upgradable CPU socket	$499.00
486-33 256K CACHE	$995.00
486-33 256K CACHE 3 Local Bus Slots	$1395.00
486-50 256K CACHE	$1395.00
486-66 256K CACHE	$1695.00
486-33 EISA	$2495.00
486-50 EISA	$2645.00

MONITOR SPECIALS

3 year warranty

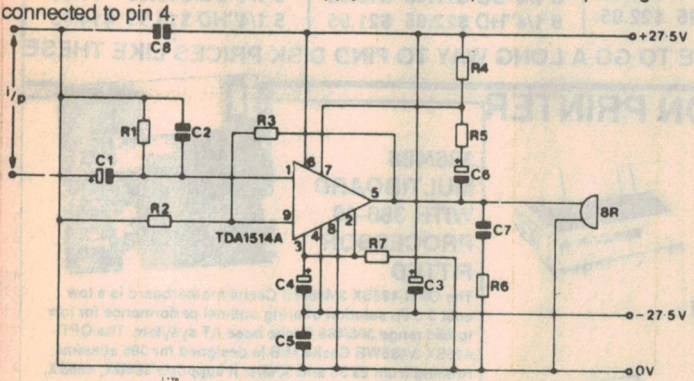
SUPA VGA COLOUR MONITOR "3 YEAR WARRANTY"
This stylish and reliable monitor has been designed for Australian conditions & comes with a 3 year warranty.
SPECS: cte: 14" 90° deflection, dark tint, non-glare.
Display size: 245+/5mm x 180+/-5mm x 180+/-5mm
Resolution: (max): 1024 x 768.
only $429.00

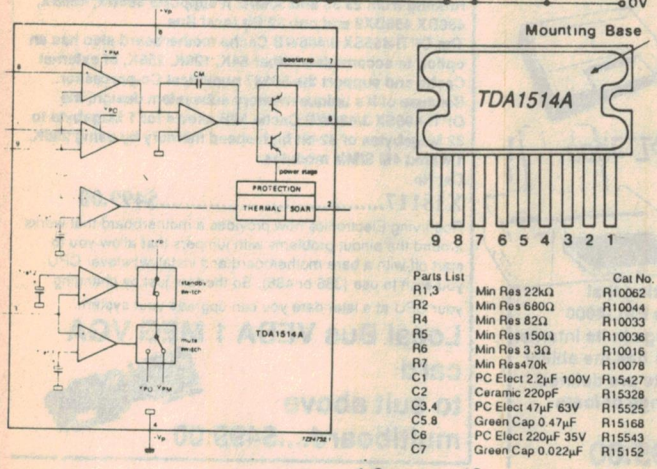
SUPER VGA *NEW* MULTISCAN COLOUR MONITOR 0.28" D.P NON-INTERLACED 1024 x 768...$549.00

TDA1514A

50 WATTS INTO 4 OHM ±27 Power Supply
A HIGH QUALITY AUDIO AMP IN A 9 PIN FLAT PACK.

This amplifier will deliver up to 40W into 8ohm load with a ±27.5V power rail. The device is designed to meet the requirements of digital sound sources such as Compact Disc. The total harmonic distortion at 32W is less than 0.0032%. An output mute Circuit prevents switch-on and switch-off clicks and the device is totally protected against short circuits and thermal runaway. The device will deliver 25W into 8ohm with a ±22V supply or 12.5W into 8ohm with a ±16V supply. The metal plate on the package is connected to pin 4.



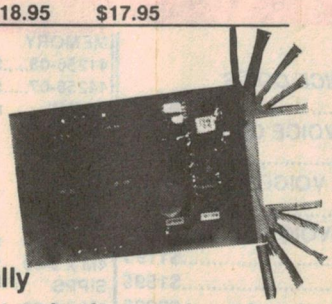


Parts List		Cat No.
R1,3	Min Res 22kΩ	R10062
R2	Min Res 680Ω	R10044
R4	Min Res 82Ω	R10033
R5	Min Res 150Ω	R10036
R6	Min Res 3.3Ω	R10016
R7	Min Res470k	R10078
C1	PC Elect 2.2µF 100V	R15427
C2	Ceramic 220pF	R15328
C3,4	PC Elect 47µF 63V	R15525
C5 8	Green Cap 0.47µF	R15168
C6	PC Elect 220µF 35V	R15543
C7	Green Cap 0.022µF	R15152

	1-9	10+
Cat. No. U10183.. TDA1514A.....	$18.95	$17.95

Complete kit including Heatsink

Cat No.K10320...$54.95



Double Sided plated through fibreglass PCB. Especially designed with large copper tracks for use in schools and the commercial environment. E10325.....,.. $19.95

EPROM SPECIALS

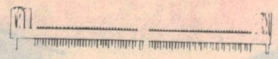
	1-9	10-25	25+
27C64-20	$4.50	$3.90	$3.50
27C256-20	$5.00	$5.00	$4.50
27C512-15	$6.00	$5.50	$5.00

PLEASE NOTE 1 MEG AND 4 MEG EPROMS ARE NOW IN STOCK PHONE FOR PRICES.

NEW PLASTIC BOXES

PLASTIC BOXES WITH PLASTIC LIDS. COMES WITH 4 SCREWS. COLOUR BLACK.

H10128 83 x 54 x 28mm.....$1.95
H10126 130 x 68 x 41mm....$2.50
H10122 150 x 90 x 50mm.....$3.95
H10124 195 x 113 x 60mm..$4.95



32 BIT SIMM MODULE

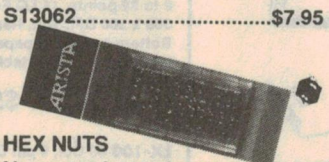
This is the way RAM is heading. The 72 pin Simm Socket. Holds up to 8 Meg. Has strong metal clips and is designed for easy insertion.

P10539.....$9.95

NUMERIC KEYPAD

These are ideal for telephone dial projects, security, systems, 4 x 3 encoded keypad. 10 digits with 2 utility keys. Black in colour.

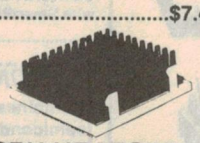
S13062.....$7.95



HEX NUTS

Hexagonal nuts for sercuring inline "D" computer connectors • 50 nuts per set

P10936.....$7.45

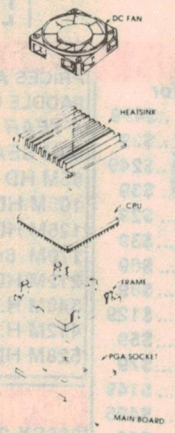


486 CPU HEATSINK

Losing data? Your system not as reliable as it shoud be? Then your CPU may be runninga little hot. Place a CPU Heatsink on it and increase the reliability out of your processor. Comes complete with mounting clip to go directly on to your CPU.

H10610.....$19.95

A GREAT WAY TO KEEP YOUR COOL



COOLING CAP FOR INTEL 486 CPU

Here's the latest device for cooling your CPU. The Cooling Cap is a small fan which incorporates a heatsink which clips over the CPU with the plastic clip provided. No longer will you have to worry about Hot CPU's. When connecting the fan, please take care when you remove CPU so not to damage it. We can fit the cooling fan for you for a small fee.

Comes with a piggy back plug.

H10611.....$39.95

AUTOCAD QUICK REFERENCE (3rd Edition)

Computer-aided drawing and design is easy with Que's AutoCAD Quick Reference, 3rd Edition! This compact guide is an instant reference for the most commonly used commands, options, and latest enhancements of this industry-standard CAD software - featuring those new to release 12.

This versatile reference offers easy-access information that makes creating 1-, 2-, and 3-dimensional drawings, models, and scales efficient - and effective.

All of AutoCAD's most essential features are covered, including AutoCAD key system variables and dimensioning.

AutoCAD Quick Reference, 3rd Edition, makes it easy to:

*Create powerful and attractive drawings and designs
*Use essential AutoCAD commands
*Properly use AutoCAD Release 12's quicker, cleaner codes.

B23006.....$19.95

The First Book of CorelDRAW! 3

With CorelDRAW! 3, even ordinary PC users can be graphic designers! Learn the ins and outs of this powerful program the easy way - with The First Book of CorelDRAW! 3. Whether you're a novice at design or an experienced professional new to CorelDRAW!, you'll appreciate this book's clear, concise instructions and helpful tips.

Quick Steps summarize the procedures you need to know:

*Drawing simple lines and shapes
*Adding color and shading
*Moving, rotating, and sizing objects
*Adding 2-D and 3-D perspective

B22012.....$37.95

USING BORLAND C++3 (2nd Edition)

With Que's Using Borland C++3, 2nd Edition, you can become proficient with the latest features and utilities of Borland C++3.

The focus is on great results. You learn the language while learning to program in both the DOS and Windows environments with this superior complier. Whatever your experience level, you learn to get comfortable with Borland's prestigious integrated Development Environment. Along with all of Borland's easy object-oriented capabilities, you discover how to use source code and object files, load modules, add flow to program logic and execution, and write C programs - both simple and sophisticated.

Learn how to. . .

*Develop successful software projects
*Write prototypes for functions and pass arguments
*Successfully implement loop control statements and strings
*Build, compile, and test your programs
*Design and write impressive Windows applications with Borland C++3
*Complete high-grade, object-oriented programming projects

B21290.....$61.95

WE HAVE A PRINTER RIBBON TO SUIT ALMOST EVERY PRINTER!

ADMATE D.P 80
C21238 1-9 $18.95 10+ $17.05

AMSTRAD DMP 2/3000
C21190 1-9 $17.95 10+ $15.95

APPLE IMAGEWRITER
CITOH 8510
C22051 1-9 $13.95 10+ $12.95

BROTHER 1509
CENTRONICS 220
C21208 1-9 $19.95 10+ $17.95

BROTHER 1824L
C21236 1-9 $25.96 10+ $22.95

BROTHER AX10/40
C21240 1-9 $18.95 10+ $16.95

BROTHER CE/EM
C21242 1-9 $18.95 10+ $16.95

BURROUGHS B.300
C21244 1-9 $24.95 10+ $22.95

CANON A40/A50/115A
H80/1080
C22039 1-9 $16.95 10+ $15.95

CANON AP100/150
C21246 1-9 $18.95 10+ $16.95

CANON AP11, 200/400
C21248 1-9 $18.95 10+ $16.95

CITIZEN 120D
C21210 1-9 $10.95 10+ $9.95

CITIZEN 200 & 140 COLUMN
C21114 1-9 $29.95 10+ $27.95
Sorry. No picture available

CITIZEN 200 & 140 BLACK
C21116 1-9 $16.95 10+ $14.95

CITIZEN PN48 S/STRIKE
C22201 1-9 $16.95 10+ $14.95

COMMODORE 4023/698
C21180 1-9 $12.95 10+ $10.95

DIGITAL L.A.34/100
C21250 1-9 $18.95 10+ $16.95

EPSON DFX
C22007 1-9 $18.95 10+ $16.95
Sorry. No picture available

EPSON DFX5000
C21234 1-9 $39.95 10+ $35.95

EPSON ERC 03
C21252 1-9 $18.95 10+ $16.95

EPSON ERC 23
C21222 1-9 $18.95 10+ $16.95

EPSON EX800
C21216 1-9 $18.95 10+ $16.95

EPSON LQ2550
C21218 1-9 $18.95 10+ $16.95

LQ100
C21200 1-9 $12.00 10+ $10.95

LQ1000/1010/1050/1070/FX1050
C22011 1-9 $12.95 10+ $11.95

LQ1500
C22009 1-9 $14.95 10+ $11.95

LQ200 - LQ870 MT82
C22004 1-9 $11.95 10+ $10.95

LX1000 RX/FX/MX/RX80
C22002 1-9 $12.95 10+ $10.95

LX400/800/850 MX/RX80
C22031 1-9 $10.95 10+ $9.95

LX80 GX80 LX86
C22003 1-9 $9.95 10+ $8.95

FUJITSU DL1100
C21254 1-9 $27.95 10+ $24.95

FUJITSU DL3300
C21228 1-9 $18.95 10+ $16.95

HEWLETT PACKARD
2235 RUG WRITER
C21230 1-9 $29.95 10+ $26.95

PANASONIC KXP1081/
1082/1090/1091
C22034 1-9 $11.95 10+ $10.95

MANNESMAN TALLY
MT-85 /S2-72 / KAITEC
C22036 1-9 $19.95 10+ $18.95

MT81 SP/SX/DP/CP80
C22038 1-9 $19.95 10+ $18.95

NAKAJIMA AX200.240
C21256 1-9 $18.95 10+ $16.95

NEC P3/7
C21202 1-9 $18.95 10+ $16.95

NEC P5
C21206 1-9 $18.95 10+ $16.95

NEC P5300
C21232 1-9 $18.95 10+ $16.95

OKI 380/391
C21105 1-9 $14.95 10+ $12.95
Sorry. No picture available

OKI 393
C21224 1-9 $39.95 10+ $35.95

OKI 172/182/183/320/321
C21104 1-9 $12.95 10+ $11.95

PAN KXP1124 / KXP1180
C22024 1-9 $19.95 10+ $17.85

PANASONIC KXP1540.158
C21258 1-9 $22.95 10+ $19.95

PRINTRONICS P300, 600
SPOOL
C21260 1-9 $29.95 10+ $26.95

QUME IV MULTI STRIKE
C22023 1-9 $14.95 10+ $13.95

RDC DIABLO HYTYPE II FILM
C22021 1-9 $10.95 10+ $9.95

SEIKOSHA BP5420
C21204 1-9 $19.95 10+ $17.95

SEIKOSHA SP800/1000
AMSTRAD PCW8256
C21212 1-9 $18.95 10+ $16.95

STAR LC/ NX2410 IBM5538
C22047 1-9 $14.95 10+ $12.95

STAR NL10/NX10
C21214 1-9 $18.95 10+ $16.95

STAR NR/NX 15
C21220 1-9 $18.95 10+ $16.95

STAR NX1000 / IBM5537
C22048 1-9 $11,95 10+ $10.95

STAR NX1000C COLOUR
C22040 1-9 $29.95 10+ $26.95

TOSHIBA P1350
C22027 1-9 $23.95 10+ $21.95

TOSHIBA P321/341
C21226 1-9 $18.95 10+ $16.95

rie ROD IRVING ELECTRONICS. Est. 1977. 100% Australian owned & run.

- **HEAD OFFICE:** 56 RENVER RD, CLAYTON. ACN: 005 428 437
  PH: (03) 543 7877. FAX (03) 543 2648.
- **CITY:** 48 A'BECKETT ST. MELBOURNE.
  PH. (03) 663 6151 / (03) 639 1640. FAX: (03) 639 1641.
- **OAKLEIGH:** 240C HUNTINGDALE RD, OAKLEIGH.
  PH: (03) 562 8939. FAX: (03) 562 8940.
- **NORTHCOTE:** 425 HIGH ST. NORTHCOTE.
  PH.(03) 489 8866. FAX: (03) 489 8131.
- **SYDNEY:** 74 PARRAMATTA RD, STANMORE.
  PH: (02) 519 3134. or (02) 565 1458. FAX: (02) 516 5024.
- **ADELAIDE:** 241-243 WRIGHT ST. ADELAIDE.
  PH: (08) 211 7200 FAX: (08) 211 7273.

Stop Press: Adelaide store now open:
Mon-Thur: 9-5.30pm Fri: 9-8.30 pm Sat: 9-1.00 pm.

BLUESTAR COMPUTERS: (COMPUTER PRODUCTS ONLY)
- 271 MAROONDAH HWY. RINGWOOD.
  PH: (03) 870 1800. FAX: (03) 879 3027.
- **BLUESTAR COMPUTERS - CONCORD.**
  (COMPUTER PRODUCTS ONLY)
  GROUND FLOOR 115-117 PARRAMATTA RD, CONCORD.
  PH: (02) 744 5526. FAX: (02) 744 5405.
- **TOLL FREE MAIL ORDER HOTLINE:** 008 33 5757.
  FAX ORDERS: (03) 543 2648 (STRICTLY ORDERS ONLY)
- RIE BULLETIN BOARD: (03) 562 7903 For Specials, Info & more.

OR VISA OR OR OR

MAIL ORDER HOTLINE: 008 33 5757

POST & PACKING CHARGES

$1.00 $9.99...$3.75	$50-$99.99..$6.50
$10-$24.99....$4.00	$100-$199...$7.50
$25-$49.99....$4.95	$200-500.....$8.00

Overnight Jet Air freight up to 3kg... $8.00
Overnight Jet Air freight up to 5kg $14.00

All Sales Tax exempt orders to:
RITRONICS WHOLESALE
56 Renver Rd, Clayton, Victoria.
Ph: (03) 543 2166 Fax: (03) 543 2648
Mail order & Correspondence
P.O BOX 620, Clayton, Victoria, 3168.

Construction project

Select-a-chime programmable doorbell

Want to build an electronic doorbell, but can't get hold of those fancy dedicated 'melody chips'? Then use this design, which lets you program your own tune. With a maximum of 14 notes possible, it can even play two different tunes — one for the front door and one for the back.

by PETER MURTAGH

I recently moved house, and was forced to leave behind my 'Autochime' electronic doorbell. Its design (*EA* September 1979) used a dedicated chip which cycled through 24 stored tunes. But like many specialised ICs, the chip is no longer available. So to replace my old doorbell, I decided to settle for a simpler design which plays a constant tune, but one which can be re-programmed, if desired. (I will miss the party-goers who used to insist on playing all 24 tunes on my old unit!)

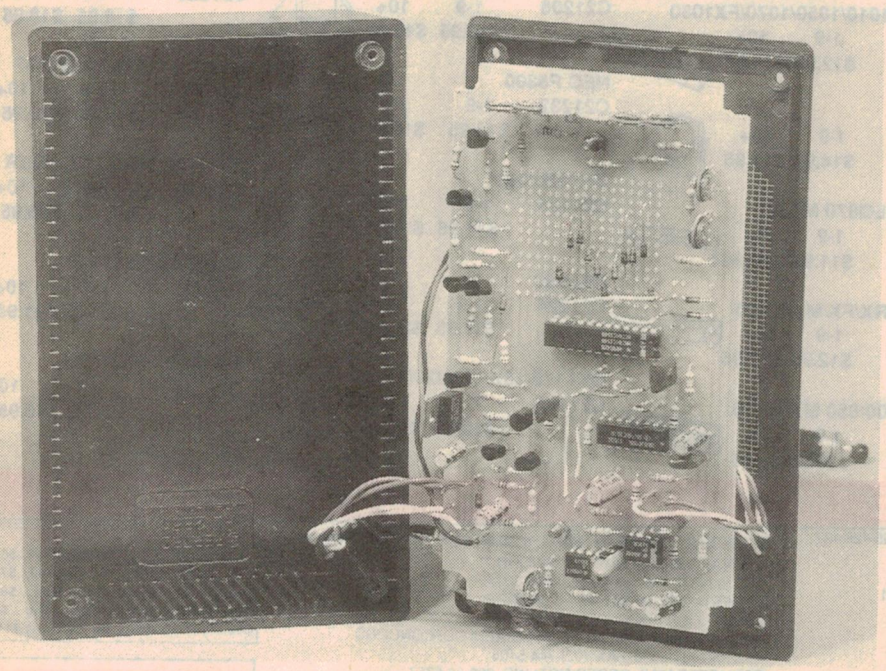
To generate and play the various notes, this circuit uses four integrated circuits. The first IC (a 555) determines the tempo of the tune, while the second (another 555) generates the notes themselves. The frequencies of the various notes are obtained by varying the voltage applied to the 'control voltage' pin of this second IC. Resistors and trimpots provide the adjustments to tune each note.

IC3 (74HC161) is a presettable 4-bit binary counter. This chip is normally reset to count from zero, but its preset can be used to make it start at any count in the 16-bit cycle. So you can activate the doorbell from the back door, for example, to play a completely different tune, or even play the second half of the front door tune.

And finally, IC4 is a 4-to-16 decoder (74HC154), whose 16 outputs are used to activate the various notes, pauses, and to end each sequence. Because any sequence of notes begins with a blank (to allow all capacitors to become fully charged), and must be ended (to prevent the tune repeating), this means that there is a total of 14 controllable outputs. This number of course will drop to 12 if two separate tunes are programmed.

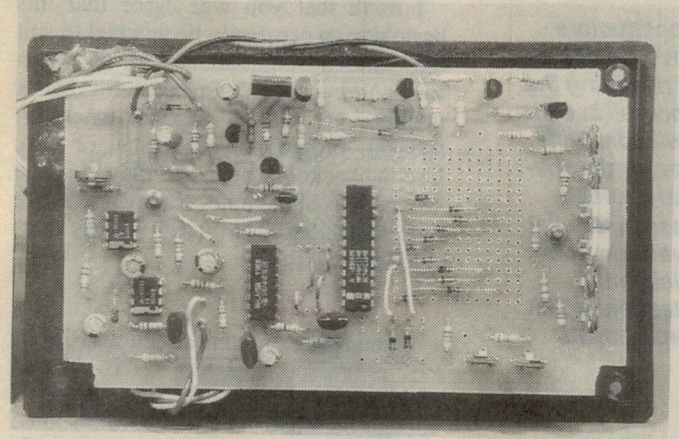
If you look at the schematic diagram you will notice that each output of IC4 is isolated with a diode. This allows different outputs to activate the same note by simply soldering multiple links to the same note pad-track. (Unfortunately the 1C4 does not have open-collector outputs, which would have made the isolating diodes unnecessary.) On the PCB, the diodes themselves are used to make these links.

We decided to use the 74HC chips be-

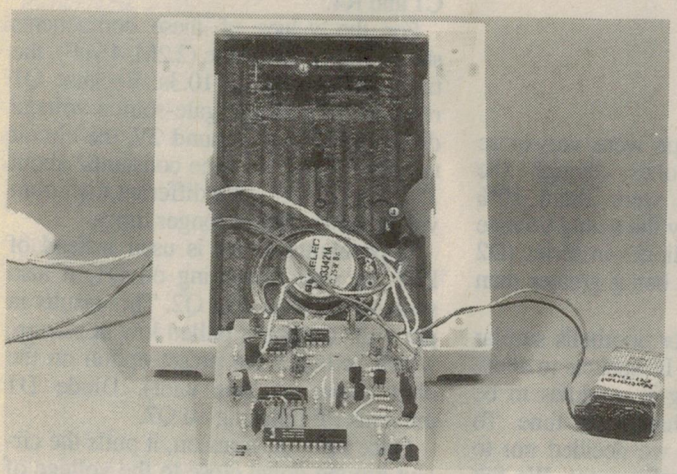


The PCB fits inside the Jiffy box but notches need to be made at the four corners to clear the mounting pillars. The speaker and 9V battery are mounted under the board, which is bolted to the lid of the box, component-side up.

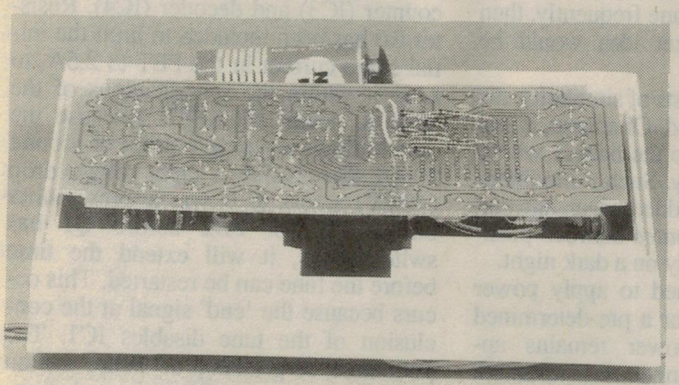
Select-a-chime doorbell



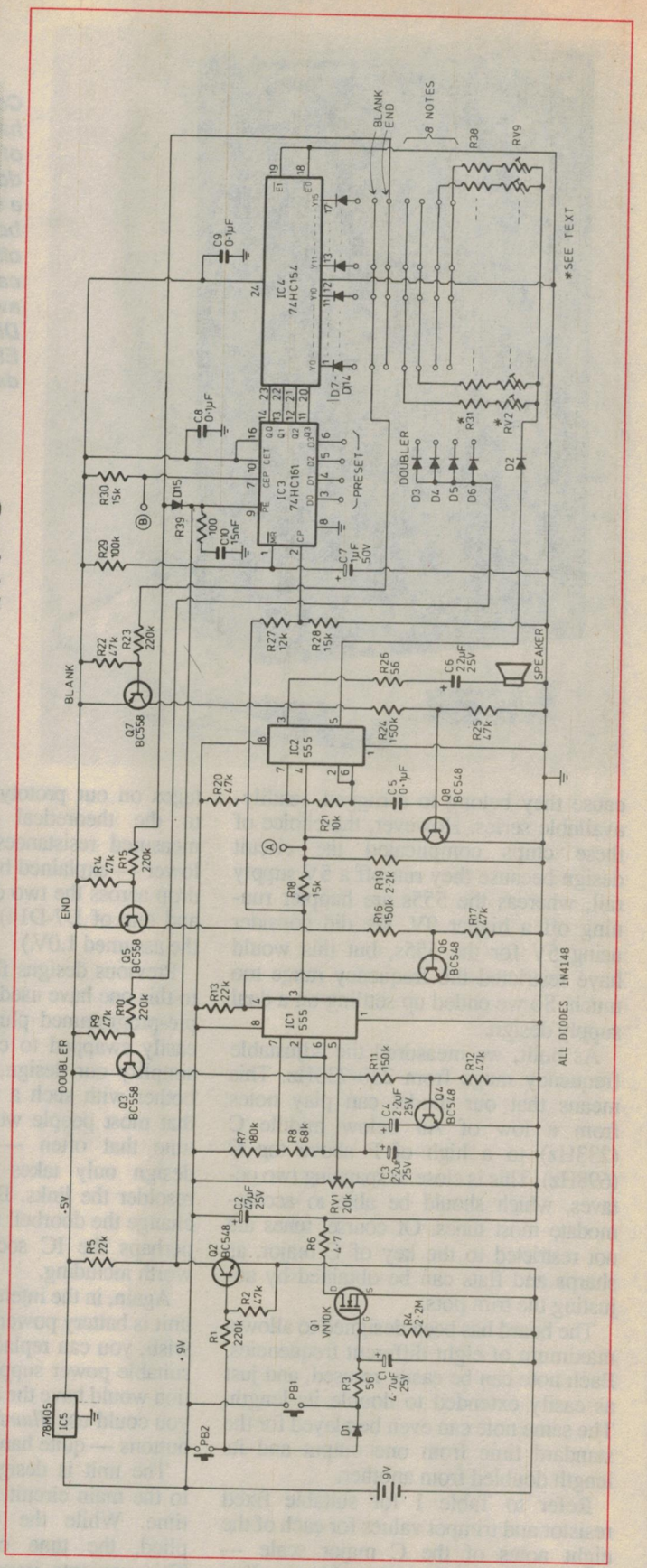
This photo shows the four vertical wire loops (lower centre) which preset IC3 to binary value 0101 (inputs D3-D0, pins 6-3), to start the second tune at position 5. The 11 diodes to the right of IC4 determine the blanks, tune and end, while the wire links to the two lower diodes double the length of outputs Y4 and Y9.



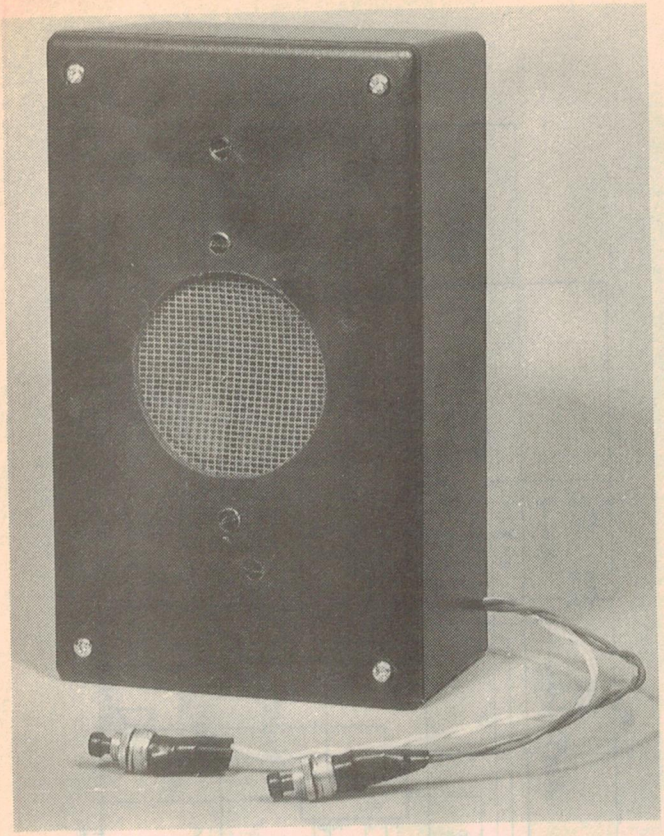
After minor surgery to the DSE case, the PCB fits inside. You need to remove the existing AA cells moulding for more clearance. The 9V battery is positioned to the side of the board, in the side channel.



This photo shows the PCB, installed upside down. This allows the note diodes to be soldered directly to the copper track — to make it easier if you decide to change the tune some time in the future.



The schematic diagram shows the three main sections of the circuit: the timed power supply built around MOSFET Q1; the two 555s (IC1 and IC2) which control the tempo and note frequency generated; and the binary counter (IC3) with its 16-output decoder (IC4).



Constructors have the choice of mounting the doorbell in either a standard jiffy box, or the special doorbell case (opposite) available from Dick Smith Electronics' kit department.

cause they belong to a rugged, readily-available series. However, the choice of these chips complicated the circuit design because they run off a 5V supply rail, whereas the 555s are happier running off a higher 9V. We did consider using 5V for the 555s, but this would have restricted the frequency range too much. So we ended up settling on a dual supply design.

As built, we measured the adjustable frequency range from 230-730Hz. This means that our model can play notes from a low of A# below middle C (233Hz) to a high of F above top C (698Hz). This is close to spanning two octaves, which should be able to accommodate most tunes. Of course, tunes are not restricted to the key of C major, as sharps and flats can be obtained by adjusting the trim pots.

The board has been designed to allow a maximum of eight different frequencies. Each note can be easily re-used, and just as easily extended to double its length. The same note can even be played for the standard time from one output and its length doubled from another.

Refer to Table 1 for suitable fixed resistor and trimpot values for each of the eight notes of the C major scale — labelled Rx and RVx. The table also lists the theoretical values of each frequency, the control voltage at pin 5 of IC2 and the total resistance of R plus RV to achieve these frequencies. (The measured voltages on our prototype were very close to the theoretical ones, though the measured resistances were about 10% lower — explained by the actual voltage drop across the two diodes in series (D2 and one of D7-D14) being greater than the assumed 1.0V.)

Previous designs for doorbells similar to this one have used IC sockets to allow pre-programmed plug-in modules to be easily swapped to change the tune. To simplify our design, we decided not to bother with such a refinement. We felt that most people would not change the tune that often — and anyway, our design only takes a few minutes to resolder the links. But, if you intend to change the doorbell tune frequently, then perhaps the IC socket idea would be worth including.

Again, in the interests of simplicity, the unit is battery powered. Of course, if you wish, you can replace the battery with a suitable power supply. Such a modification would have the added advantage that you could use *illuminated* doorbell pushbuttons — quite handy on a dark night.

The unit is designed to apply power to the main circuit for a pre-determined time. While the power remains applied, the tune cannot be restarted. This prevents impatient callers sounding a continuous melody! While you would normally set the timing to be just long enough to play your selected tune, you could easily extend the period considerably to discourage annoying multiple plays.

I think that you will agree that this basic design can easily be adapted to suit the various requirements of constructors. Add a bigger speaker for better quality, or add a second extension speaker. Program in one tune, or two. Use the backdoor button to play only the second half of the tune, or play a separate tune altogether. The design allows considerable flexibility.

How it works

When either of the pushbuttons PB1 or PB2 is pressed, capacitor C1 is charged rapidly via resistor R3. This applies a voltage between the gate and the source of transistor Q1 (an enhancement mode power MOSFET), which remains on until C1 discharges via resistor R4. Because FETs have an extremely high input impedance, there is negligible leakage through Q1, so the power-on time constant is determined by the values of only C1 and R4.

For the values of these components shown on the schematic (2.2M, 4.7uF), the time constant RC is 10.3s. Because Q1 remains on until the gate-source voltage drops from 9V to around 2V, the circuit remains on for 1.5 time constants, about 15s. Replace R4 with different meg ohm values for shorter or longer times.

If pushbutton PB2 is used instead of PB1, as well as turning on Q1, it also switches on transistor Q2. This results in pin 9 of IC3 being pulled low at startup, which activates the preset option on the chip (more on this later). Diode D1 prevents PB1 turning on Q2.

Once FET Q1 turns on, it pulls the circuit ground down close to the voltage of the negative terminal of the battery. This effectively enables the +9V supply rail for the two 555s (IC1 and IC2), and the +5V rail, via regulator IC5, for the binary counter (IC3) and decoder (IC4). Resistor R6 has been included to limit the initial surge current in the FET to 2.5A, to keep it within the specifications of the VN10K power MOSFET. Because the circuit draws a typical current of around 30mA, there is only a slight voltage drop (<0.2V) across it. If you re-press either button PB1 or PB2 before Q1 has switched off, it will extend the time before the tune can be restarted. This occurs because the 'end' signal at the conclusion of the tune disables IC1. The premature re-pressing of either button charges up capacitor C1 again, and so extends the holding time — IC3 can't be reset until Q1 turns off.

Resistors R7 and R8 and capacitor C3 are connected to the first 555 (IC1) to

form an astable oscillator with a 2Hz frequency, to produce the timing pulses. Its output is fed to the reset pin 4 of the second 555 (IC2), which means that IC2 (which produces the actual musical notes) is enabled only when the timing pulse is high. When pin 4 drops low, a pause is produced between notes. Because the square wave output of IC1 is high for about 80% of its cycle, the mark-to-space ratio is 4:1. If you wish to increase this ratio, then reduce the size of resistor R8; or vice versa.

Trimpot RV1 has been included, attached to the control voltage pin 5 of IC1, to make easy adjustments of the overall tempo. A clockwise rotation will decrease the voltage and increase the tempo. (The 2Hz frequency quoted above assumes that the voltage at pin 5 is around 6V.)

IC2 is also set up as an astable oscillator, with the values of resistors R20 and R21 and capacitor C5 producing a frequency of 215Hz (if its pin 5 is 6V). But the circuit attached to pin 5 means that the voltage is always less than this, so the frequency of the notes will always be higher. The various notes for our tune are produced by padding the internal voltage divider of the 555 with different value resistors to alter the voltage at pin 5. As mentioned before, Table 1 lists the values needed to set up the notes in the C major scale.

The output signal of IC2 is fed to the 8-ohm speaker via resistor R26 (which can be adjusted to alter the volume) and isolating capacitor C6.

We have already seen that the low output of IC1 disables IC2 to produce the brief pause between notes. A longer 'blank' — for pausing after a sequence of notes — is achieved by disabling the chip for a full note. This is achieved by switching on the pair of transistors Q7 and Q8 to pull pin 4 of IC2 low.

The first 555 (IC1) is similarly disabled when the complete tune has been played. An 'end' signal pulls its pin 4 low, via switched-on transistors Q5 and Q6. With IC1 disabled, there are no timing pulses to advance the counter to the next note; and the low output at its pin 3 disables IC2, which prevents any note being sounded.

Now to the working of IC3 (74HC161), the presettable binary counter. At power-up, an initial low on pin 1 (produced by R29 and C7) activates the 'master reset' which sets the counter to zero. If the doorbell was started with button PB1, pin 9 (parallel enable input) of IC3 will be high, and the preset function will be ignored. The tune will start playing from the zero position of the counter. However, if PB2 was used instead of PB1, the preset option is activated. This requires that pin 9 be held low while a positive clock pulse is applied to pin 2. Pin 9 low disables the normal 'clocking' function, but uses the pulse instead to load the preset values from inputs D0-D3 (pins 3-6) into the counter.

This sequence is achieved by using PB2 to turn on transistor Q2 to pull pin 9 low. This low continues while the button stays pressed and, via diode D15, also switches on transistors Q5 and Q6 to disable IC1. Once PB2 is released, IC1 is enabled, and immediately sends the necessary loading pulse — pin 9 remaining low for a short time delay determined by resistor R39 and capacitor C10. When pin 9 goes high, IC1 will commence to clock the counter in IC3, but starting from the binary position determined by the voltages at pins 3-6. Hence, our second tune can commence at any desired position.

At one stage of developing the circuit, components D15, R39 and C10 were not included. When PB2 was pressed, it sometimes played the full tune and sometimes the shortened form — depending on how long the button was pressed! Because IC1 was not disabled and there was no time delay on pin 9, IC3 had to wait for the second pulse from IC1 to load the preset values — the turn-on pulse occurred too quickly. But this doesn't happen until 0.5s later. Hence, a brief press on PB2 sent pin 9 high before the loading pulse arrived, and so the doorbell played the full tune. (When the button was kept pressed for over 0.5s, there was no problem.)

When using the preset option of IC3, each input (D0-D3) must be connected to either a high (+5V) or low voltage. Blocks of pads on the PCB are provided for these connections, above and below the tracks connecting IC3 and IC4. The bottom block is positive while the top one is negative. The loops of wire making these connections can be seen in the PCB photo.

When programming your tune, remember that any sequence of notes must begin with a blank, otherwise an initial off-key or drawn-out note will be played; and of course it must also be terminated. Any outputs in the sequence not connected to one of the control tracks will still result in a note being played — the lowest frequency that IC2 can produce, since its pin 5 is at 6V.

Once a sequence of notes has been started, the clock pulses from IC1 are fed into pin 2 of IC3 to cycle it through its 4-bit binary count. Note that these pulses are fed via a voltage divider (R27/R28) to reduce the 9V output to a 5V input — necessary because of our dual supply rail.

The four outputs (Q0-Q3) are fed into IC4 (74HC154) which decodes the 4-bit binary input into 16 individually active (active low) outputs, Y0-Y15. These outputs control what you hear, depending on which pad-track their isolating diodes are connected to — blank, end, or one of the eight programmable notes. Each output

PARTS LIST

Miscellaneous

PCB 141x81mm, coded 93sac3
9V battery (216-type)
8 ohm 57mm mini speaker
2 momentary make pushbuttons, PB1 PB2
2 25mm insulated spacers
large jiffy box, 50 x 90 x 150mm, or DSE case
hookup wire, solder, nuts and bolts, etc.

Resistors

All 1/4W, 5%

4	220k	R1,R10,R15,R23
8	47k	R2,R9,R12,R14,R17,R20, R22,R25
2	56 ohm	R3,R26
1	2.2M	R4
2	22k	R5,R13
1	4.7 ohm	R6
1	180k	R7
1	68k	R8
3	150k	R11,R16,R24
4	15k	R18,R28,R30,R31
1	2.2k	R19
2	10k	R21,R29
1	12k	R27
1	6.8k	R32
1	4.7k	R33
1	3.9k	R34
1	3.3k	R35
1	1.8k	R36
1	1.5k	R37
1	1.2k	R38
1	100 ohm	R39
1	20k vert. trimpot	RV1
2	10k vert. trimpots	RV2,RV3
2	5k vert. trimpots	RV4,RV5
2	2k vert. trimpots	RV6,RV7
2	1k vert. trimpots	RV8,RV9

Capacitors

PC-mount electrolytic:

1	4.7uF,25V	C1
1	47uF,25V	C2
2	2.2uF,25V	C3,C4
1	22uF,25V	C6
1	1uF,50V	C7

polyester (greencap):

3	0.1uF	C5,C8,C9
1	15nF	C10

Semiconductors

15	1N4148 signal diodes D1-D15 (all 15 may not be needed)
1	VN10K power MOSFET Q1
4	BC548 NPN transistors Q2,Q4,Q6,Q8
3	BC558 PNP transistors Q3,Q5,Q7

ICs

2	555 timer IC1,IC2
1	74HC161 counter IC3
1	74HC154 decoder IC4
1	78M05 regulator IC5

is connected to *one only* of the tracks — the track functions are mutually exclusive. But of course there is no limitation on how many diodes can be joined to the same pad-track, provided that they come from different outputs.

However, a second connection to the same output — with its own isolating diode D3-D6 — can be made to double the length of either a pause or note. The diode isolation allows the same note to be doubled on one output, but played for the standard time on another. The PCB pattern allows for up to four outputs to be doubled in length.

In order to achieve these doubled notes, transistors Q3 and Q4 switch in a second 2.2uF capacitor C4, in parallel with C3. The two transistor combination — as with the blank and end switches — isolates the 5V and 9V rails, to allow the 5V logic of IC4 to control the 9V 555s.

The dual supply rail is also the reason for including diode D2. When the voltage at pin 5 of IC2 is 6V, diodes D2 plus the output isolating diode (D8-D15) drop the voltage to approximately 5V — a level which will not interfere with the operation of IC4.

And why is the output of IC1 fed to IC2 via the voltage divider R18/R19, rather than directly? This was done to eliminate the 'dying gasp' of the circuit as transistor Q1 switched off. We found that, as the circuit voltage died away, the end signal from IC4 that disabled IC1 died before the 555's supply did. IC1 then delivered a weak but audible signal to IC2 during that last 'free' second! By substantially reducing the input to IC2 — which doesn't affect its normal operation — this annoying 'gasp' was eliminated.

Construction

There are two different enclosures in which you can mount the Select-a-Chime — a standard jiffy box, or a special doorbell case from Dick Smith Electronics (more on the DSE case later).

Commence your construction by cutting out a 50mm diameter hole in the centre of the lid of the jiffy box. Fashion two small metal clips to hold the 57mm speaker securely to the lid, then drill the holes for their bolts. We also used these two bolts to hold in place a piece of fibreglass flyscreen wire, to provide physical protection for the speaker cone.

Since the PCB is also bolted to the lid — through two 25mm insulated spacers — you need to drill two more holes. To mark the correct positions, use the PCB as a template, with the copper side down on the inside of the lid.

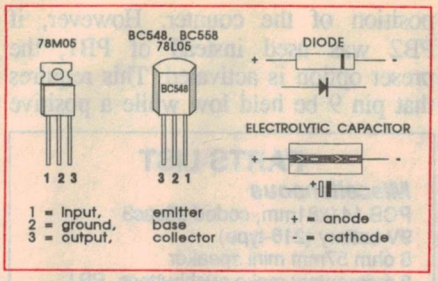


Fig.2: The pinouts for the polarised components. Note that the leads on the 5V regulator shown in Fig.1 (78M05) differ from those on the more common 78L05.

There are *four* hole outlines shown; use the two centred near each end — the side two are for the DSE case. This setup means that, when the lid is removed, the component side is exposed to allow easy adjustments to any trimpot. But the board has to be removed to change the positions of the note diodes.

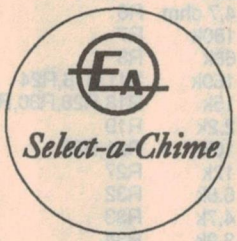


Fig.3: The actual size artwork for the 'Select-a-Chime' logo, designed to fit in the circular recess on the DSE case front panel. It could also be used on the jiffy box, if desired.

Before drilling these holes, decide whether you wish to mount the PCB as mentioned above — copper side towards the lid, with the components up — or as shown in the photo of the DSE case, with the copper uppermost and the note diodes soldered directly onto the copper track. This latter method means that the notes can be changed without removing the PCB from the lid.

Next drill the holes in the base of the box to fasten the unit to the wall, and drill one more hole for the wires to the external pushbuttons.

Then start your soldering. Follow the usual rules for PCB construction, making certain that the polarised components are inserted correctly. Refer to Fig.2 for these components, noting the different pin arrangement (for IC5) between the 78M05 and more usual 78L05 — only the ground is in the same position. The PCB overlay diagram shows the 78M05 chip, which we used because it was cheaper.

Take extra care with the CMOS chips, with regard to grounding yourself and your soldering iron to remove problems with static charge. For added protection, it is a good idea first to solder the ground and supply pins on these chips.

It is also a good idea to build the circuit up in sections, and check that each one works before going on to the next. For example, build the power section, then the timing pulser (IC1) and the note generator (IC2).

Next progress to the counter (IC3) and decoder (IC4). Voltage checks on supply pins, and inputs and outputs

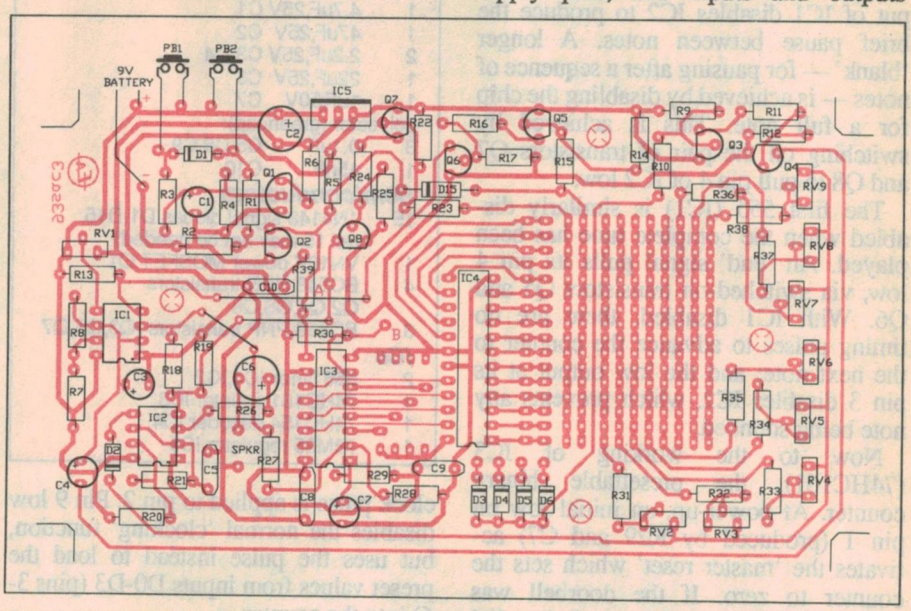
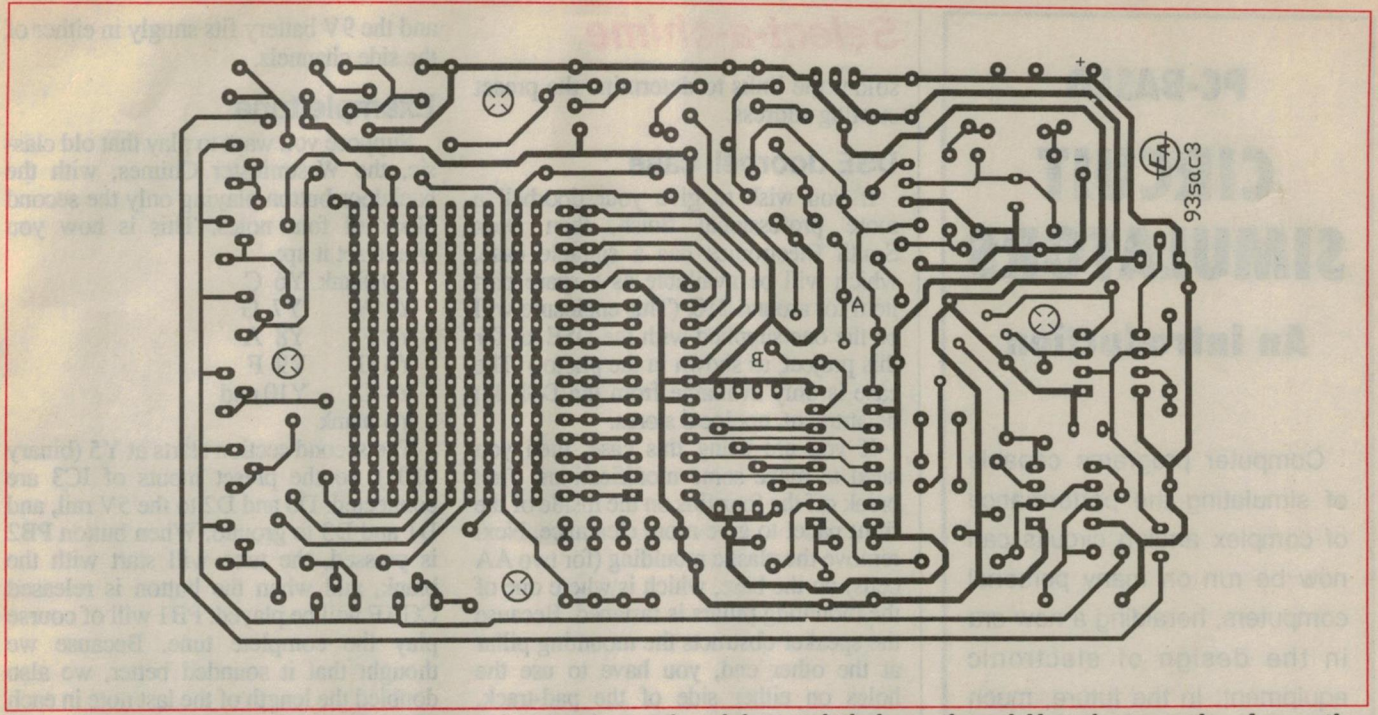


Fig.1: The PCB overlay diagram shows the series of pad-tracks to which the 16 outputs of IC4 can be linked by diodes to give a blank, end of sequence, or one of eight note frequencies. Diodes D3-D6 allows up to four of these outputs to be doubled in length.



Here is a pattern for the PCB, shown actual size, for those who wish to etch their own board. Note the two pairs of mounting holes — one for use with the DSE case and one for a standard jiffy box.

should isolate any bad joints that prevent correct operation.

When all the circuit is working, decide on what tune(s) you intend to use, and set up the notes required. Alternatively, you might decide — as we did — to set up the eight notes to make one octave of the C major scale, to make it easier to change tunes in the future. When using the diodes to make the connections to the pad-tracks, use the right hand column of IC4's output pads. Leave free the left hand column for any 'doubling', to avoid crossovers. However, because of the lack of space and because they weren't doubled, we did in fact use the left hand pads for the blanking diodes.

When you are dealing with note or pause doubling, the isolating diodes D3-D6 are already mounted on the board, so wire links will need to be used. The method of linking up is clearly shown on the PCB photo.

Remember that there are also three other wire links needed on the PCB, all positioned near resistor R30 (refer to Fig.1, the PCB overlay diagram). Failure to install these will disable the blank and end functions, and also prevent the clock pulses reaching IC3.

Table 1

Note	V_{CON}	R_{TOT}	Rx/RVx
C 262Hz	5.35V	22.3k	15k+10k
D 294Hz	4.94V	12.4k	6.8k+10k
E 330Hz	4.53V	8.0k	4.7k+5k
F 349Hz	4.33V	6.6k	3.9k+5k
G 392Hz	3.92V	4.7k	3.3k+2k
A 440Hz	3.51V	3.4k	1.8k+2k
B 494Hz	3.10V	2.4k	1.5k+1k

Finally, find a spot to position the battery (9V, 216-type). We found that there was just enough room to slide it between the lid and the PCB. But because the exposed copper tracks face the lid, you will need to insulate the metal battery case — and also the speaker magnet — to avoid the risk of shorting. We wrapped the battery in 'bubble wrap' and put a few strips of insulating tape over the magnet.

Check that none of the components touch the bottom of the box when the lid and PCB are inserted. Our 5V regulator chip just touched, so a slight bending of its leads solved the problem.

Tuning the notes

The easiest way to tune the notes is to use a frequency counter, if one is available. Disconnect the speaker from the circuit while you do this, as its coil inductance can affect the reading. If such a counter is not available, then refer to Table 1 for the voltage reading at pin 5 of IC2 for each note. Alternatively, use the resistance values that are listed. These values should put you in the right region for setting the various notes — but a good ear is needed for the fine tuning. If you are not particularly musical, borrow a friend who is!

In order to tune each note, solder the cathode of diode D8 to output 1 (Y0), but don't yet solder its anode to the blank pad-track. Instead, make temporary connections between the anode and each of resistors R31-R38 (to the side furthest from their corresponding trimpots RV2-RV9).

Before connecting the battery, short the contacts of PB1 (to avoid having to keep pressing the button), and 'nobble' the counter by pulling pin 7 of IC3 low. This is easily done by connecting test point B to ground at one of the series of pads immediately below it (used for zero value presets).

Then connect the battery. You should hear a pulsating note of the same frequency. Next pull pin 4 of IC2 high, by connecting test point A to the 9V rail (at one of the pushbutton or battery pins at the top left of the PCB). This will make the note sound continuously (or the frequency counter give a steady reading).

Now you can adjust RV2 until the first note has its correct frequency. Then move your temporary connection — leaving everything else connected — from resistor R31 to R32, and adjust RV3 for the second note.

Continue until all eight notes are tuned. Disconnect the battery and remove the three temporary connections.

With all the notes set up, solder the diodes to play your preferred tune. Output Y0 should be a blank, Y1 is the first note to be played, Y2 the next, etc.

On our circuit, Y10 ended the sequence. To implement the separate tune for the backdoor button, you also have

Select-a-chime

solder the links to determine the preset starting address.

DSE doorbell case

If you wish to give your doorbell a more professional finish, then Dick Smith Electronics has a suitable case, which will be available as a spare part item for around $10. (This enclosure will be the one supplied with the DSE kit for this project, as shown in the photo.) The case is only available from the DSE kit department, not local stores.

If you are using this case, then you need to make some modifications. First break off the four fins on the inside of the front panel to give more clearance. Next remove the plastic moulding (for two AA cells) on the base, which is where one of the mounting pillars is fastened. Because the speaker obstructs the mounting pillar at the other end, you have to use the holes on either side of the pad-track, rather than the centred hole near trimpot RV6. When using the PCB as a drilling template, position it on the base with the copper side up — for the components to fit in the bottom half of the enclosure.

With this case, there is no need to notch the four corners of the PCB — as is necessary with the jiffy box; and the 9V battery fits snugly in either of the side channels.

Example tune

Suppose you want to play that old classic, the Westminster Chimes, with the backdoor button playing only the second block of four notes. This is how you would set it up:

Y0 blank	Y6 C
Y1 A	Y7 G
Y2 F	Y8 A
Y3 G	Y9 F
Y4 C	Y10 end
Y5 blank	

The second section starts at Y5 (binary 0101), so the preset inputs of IC3 are connected: D0 and D2 to the 5V rail, and D1 and D3 to ground. When button PB2 is pressed, the tune will start with the blank, and when the button is released CGAF will be played. PB1 will of course play the complete tune. Because we thought that it sounded better, we also doubled the length of the last note in each of the 4-note sequences.

To add a second tune, Y11 would be blank, Y12-14 the notes, and Y15 the end. We didn't add a second tune since we only had three spare notes left.

Install your 'Select-a-Chime' and welcome your visitors with your personalised doorbell! ❖

1GHz counter

Continued from page 64

set to 'zero beat' against a frequency reference signal from a shortwave station like VNG or WWV, using a communications receiver. Or better still, probably, you can try measuring the line frequency of a TV set, when it is tuned to a national TV network and showing properly locked pictures. This should produce a reading of '15.625' on the 2MHz range.

Whatever the reference signal you use, CV1 is simply adjusted to produce the correct reading. If by chance you can't quite reach the correct reading, with CV1 at one or other extreme of its adjustment range, you may need to replace C9 with the next lower or higher value, to allow this to be done. Although the values of C9, C10 and CV1 have been chosen to allow correct setting with most crystals, a few may be just far enough away in frequency to require a change in C9. Note that if you do have to replace C9 with a 56pF or 82pF unit, the substitute should again be an 'NPO' type (black band) to ensure best stability.

The adjustment of trimpot RV1 is almost as simple, although here you need a source of steady VHF or UHF signals, with a frequency between about 70MHz and 1GHz, and an amplitude of 50mV or more. A signal generator would be ideal, or alternatively you could use a cable and attenuator box (or a 'sniffer loop') to derive a low- power signal from a small transmitter — such as an amateur radio handheld, or a UHF CB transceiver. It will help if the transmitter/transceiver is crystal or PLL synthesiser locked to a known frequency, and it should of course be *unmodulated*.

The signal concerned is fed into the counter's B input channel, and the counter range switch set to the top 1GHz range. Then you should try adjusting trimpot RV1 over its full range, noting the region where you get a correct reading of the signal frequency. Typically this should occur over about 30° of the pot's rotation. The correct final setting for the pot is in the centre of this region. This will generally provide the best sensitivity for the B channel, along with the maximum bandwidth.

Once you've performed these two adjustments, your new counter should be finished.

It only remains to attach the top of the case carefully and fit the two screws which hold everything together. Then it's ready for business. ❖

NO BRAND DISKETTES

DESCRIPTION	PER BOX 1~9	10+
3.5 DSDD	$7.25	$7.20
3.5 DSHD	$12.95	$12.50
5.25 DSDD	$4.30	$4.30
5.25 DSHD	$8.10	$8.00

QUALITY

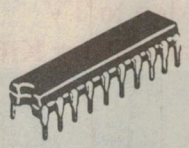
100% GUARANTEED

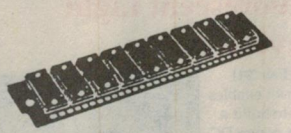
TECS

ACN 007 296 924

ELECTRONICS & COMPUTER SUPPLIERS

COMPUTER MEMORY CHIPS





	1~9	10+
41256 (256K X 1)	$2.95	$2.75
44256 (256K X 4)	$8.50	$7.95
411000 (1M X 1)	$8.50	$7.95
1M SIM	$59.00	$57.50
4M SIM	$245.00	$240.00

THE EVER POPULAR
WELLER WTCPS SOLDERING STATION

NORMALLY $159.95

NOW $145.00
THIS MONTH ONLY

SEMICONDUCTOR BARGAINS

DIODES

	1~9	10+
1N4148	$0.04	$0.03
1N914	$0.06	$0.05
1N4004	$0.08	$0.06
1N4007	$0.10	$0.08
1N5404	$0.20	$0.16
1N5408	$0.25	$0.20

BRIDGES

W04	$0.50	$0.45
BR64	$1.50	$1.30
BR104	$2.50	$2.10
BR108	$2.75	$2.35
BR254	$3.50	$3.00
BR2510	$3.75	$3.45
BR354	$3.95	$3.50
BR3510	$4.25	$3.75

LED'S

3mm RED	$0.15	$0.12
3mm GRN	$0.20	$0.18
3mm YLW	$0.20	$0.18
5mm RED	$0.15	$0.12
5mm GRN	$0.25	$0.20
5mm YLW	$0.25	$0.20
HDSP7301	$2.75	$2.50
HDSP7303	$2.75	$2.50
HDSP5301	$2.75	$2.50
HDSP5303	$2.75	$2.50

TRANSISTORS

	1~9	10+
BC547/8/9	$0.15	$0.12
BC557/8/9	$0.15	$0.12
BC327	$0.25	$0.20
BC328	$0.25	$0.20
BC337	$0.25	$0.20
BC338	$0.25	$0.20
BC639	$0.50	$0.45
BC640	$0.50	$0.45
BD139	$0.45	$0.40
BD140	$0.45	$0.40
BD681	$1.20	$1.00
BD682	$1.20	$1.00
BF469	$0.90	$0.75
BF470	$0.90	$0.75
BFY50	$1.20	$1.00
BU208A	$3.95	$3.50
BU326A	$3.95	$3.50
BU406D	$2.95	$2.60
BU407D	$2.95	$2.60
BUW12A	$6.95	$6.00
MJ15003	$6.50	$5.50
MJ15004	$6.50	$5.50
MJ2955	$2.50	$2.10
MJ802	$7.00	$6.30
MJE13007	$3.95	$3.50
MJE2955T	$1.90	$1.60
MJE3055T	$1.90	$1.60
MJE340	$1.50	$1.25
MJE350	$1.50	$1.25
TIP122	$1.50	$1.25
TIP127	$1.50	$1.25
TIP31C	$0.80	$0.70
TIP32C	$0.80	$0.70
TIP41C	$1.00	$0.90
TIP42C	$1.00	$0.90
2N2222A	$0.50	$0.45

	1~9	10+
2N2646	$1.95	$1.70
PN2907A	$0.40	$0.35
2N3055	$1.50	$1.20
PN3645	$0.40	$0.35
2N3771	$4.50	$4.00
2N3772	$4.50	$4.00
2N3773	$5.50	$5.00
2N3904	$0.35	$0.30
2N3906	$0.35	$0.30
PN4250A	$0.40	$0.35
2N6027	$1.00	$0.90
2N6123	$1.75	$1.50

VOLTAGE REGULATORS

7805T	$0.50	$0.45
7812T	$0.50	$0.45
7815T	$0.50	$0.45
7905T	$0.60	$0.55
7912T	$0.60	$0.55
7915T	$0.60	$0.55
317T	$1.00	$0.90
337T	$2.10	$1.90
723	$0.80	$0.75

74LS SERIES

74LS00	$0.50	$0.45
74LS02	$0.50	$0.45
74LS04	$0.55	$0.50
74LS08	$0.50	$0.45
74LS10	$0.50	$0.45
74LS14	$0.60	$0.55
74LS32	$0.50	$0.45
74LS74	$0.75	$0.65
74LS85	$0.65	$0.60
74LS112	$0.65	$0.60

	1~9	10+
74LS123	$1.00	$0.90
74LS138	$0.75	$0.65
74LS139	$0.75	$0.65
74LS151	$1.00	$0.90
74LS153	$0.90	$0.80
74LS157	$1.00	$0.90
74LS161	$0.90	$0.80
74LS164	$1.20	$1.00
74LS173	$1.00	$0.90
74LS174	$0.90	$0.80
74LS193	$1.00	$0.90
74LS221	$1.20	$1.00
74LS241	$1.00	$0.90
74LS244	$1.50	$1.25
74LS245	$1.50	$1.25
74LS257	$1.00	$0.90
74LS273	$1.50	$1.25
74LS293	$0.90	$0.80
74LS373	$1.50	$1.25
74LS374	$1.50	$1.25

QUALITY IC SOCKETS

	1~9	10+
8 PIN	$0.20	$0.15
14 PIN	$0.25	$0.20
16 PIN	$0.30	$0.25
18 PIN	$0.35	$0.30
20 PIN	$0.40	$0.35
22 PIN	$0.45	$0.40
24 PIN	$0.50	$0.45
28 PIN	$0.55	$0.50
40 PIN	$0.60	$0.55
64 PIN	$1.50	$1.25
64 PIN SHRINK	$2.95	$2.50

FLOPPY DRIVES

1.44M	$79.00
1.2M	$95.00

HARD DRIVES

40M IDE	$299.00
80M IDE	$399.00
100M IDE	$450.00
120M IDE	$499.00
200M IDE	$720.00

3.5 HDD BRACKET	$9.95
3.5 FDD BRACKET	$8.95
3.5 DATA ADAPTOR	$5.95
3.5 POWER ADAPT	$4.50
5.25 POWER Y-ADPT.	$4.95

MOTHERBOARDS

286-16	$119
386SX-33	$205
386DX-40 64K	$355
386DX-40 128K	$375
386DX-40 128K UPGRADABLE TO 486 & WITH 32-BIT LOCAL BUS	$425
486SX-33	$455
486DX-33 256K	$995
486DX2-50 256K	$1095
486DX-50 256K	$1295

CO-PROCESSORS

387SX INTEL	$185
387DX INTEL	$195

SuperIDE CACHING CONTROLLER

- FAST 0.3mS AVG. ACCESS TIME
- 5.0MB/sec DATA TRANSFER RATE
- 80186-16 CPU ON-BOARD
- CACHE RAM EXPANDABLE TO 8M
- USES STANDARD 256K, 1M ,4M SIM MODULES (80nS). 512K MIN. REQUIRED
- FULL 16-BIT TRANSFER
- SUPPORTS 2 IDE & 2 FLOPPY DRIVES
- REGISTER LEVEL COMPATIBLE WITH WD1003 CONTROLLERS

$225.00

NO RAM SUPPLIED

OFFICE: 1ST FLR., 289 LATROBE ST., MELBOURNE, VIC. 3000
SHOP: GRD. FLR., 289 LATROBE ST., MELBOURNE, VIC. 3000
PHONE: (03)602-3499 *FAX:* (03)670-6006

FREE PRICE LIST RETAIL & WHOLESALE

MAIL ORDER HOTLINE
(008)335-901 TOLL FREE

ALL MAJOR CREDIT CARDS WELCOME

SHOP HOURS:

MON.~THURS.	:	8:30 ~ 5:30
FRI.	:	8:30 ~ 8:00
SAT.	:	9:00 ~ 1:30

Normal prices charged, unless ad prices quoted.
Errors & ommissions excepted.

POSTAGE RATES:

$1.00 - $9.99	$3.00
$10.00 - $24.99	$3.50
$25.00 - $49.99	$4.50
$50.00 - $99.99	$6.00
$100.00 - $199.99	$7.00
$200.00 PLUS	**FREE**

CD Cleaner

We are clearing out our CD Cleaners. These cleaners use the correct motion for removing small surface scratches and general dirt and grime.

A 9220 NORMALLY $17.95

This Month Only $7.95

Save Over 50%

Up-to-date Worlds Transistors Diodes Thyristor IC's Comparison Tables II

This extremely compact book of equivalents gives brief description and specification as well as full pin assignments of 28,000 types of transistors, diodes, thyristor and IC's. An excellent reference book for professionals and hobbyists alike. 954 pages.

B 1270 **$19.95**

New From ALTRONICS

Up-to-date Worlds Transistor A-Z Comparison Table

This comparative data book contains more than 11,000 different transistors and FET's all of which are listed alphanumerically. Each page divided into 3 sections. 272 pages.

B 1275 **$18.95**

New From ALTRONICS

Up-to-date Worlds Transistor O-μ Comparison Tables

This fully comprehensive data book contains over 15,000 different transistors and FET's all or which are listed alphanumerically. Like volume 1 the manual is divided up into 3 sections, descriptive section, data section and replacement or equivalent section. 430 pages

B 1280 **$18.95**

New From ALTRONICS

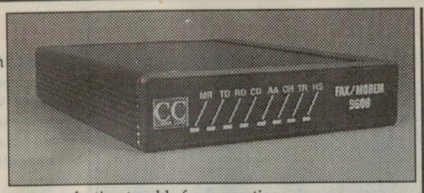
Mini Strobe Signal Lamps

New weatherproof design ideally suited to outdoor applications. Blue lens. 1 watt output. Uses Xenon tube for high energy flash. Flash rate approx 75 per minute. 12V DC 150mA. Dimensions: 70Ø x 53h mm.

S 5445 **$17.50**

New From ALTRONICS

Fax/Modem



The Comma Fax/Modem will turn your PC or MacIntosh into both a fax machine which can transmit faxes up to 9600 baud, as well as a Modem which supports both 1200 and 2400 baud. The Comma Fax/Modem uses the latest technology in digital signal processing to ensure lasting trouble free operation.

Send faxes from home. The Comma Fax/Modem operates like a fully featured fax machine. Your faxes can now be sent directly from your PC without having to print them first.You can view incoming faxes on-screen or print them using a standard dot matrix printer. Only print the faxes you want to keep - just think of the savings on expensive fax paper.

Time Saving. The Comma Fax/Modem will also receive faxes in the background while you continue to work. When faxing out, the Fax/Modem will redial an engaged number so you can be sure your faxes are sent. The software also automatically keeps a complete log of both incoming and outgoing faxes. Also supported are cover pages, broadcast faxes, and scheduling. The software keeps a database type register of regularly used fax numbers for easy retrieval.

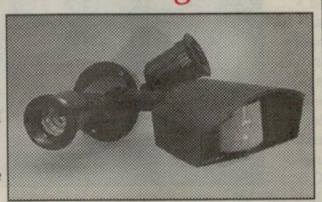
It's a modem as well. The Comma Fax/Modem is a fully AT command compatible modem. Features include V22/V22bis standards (V21/23 is an option) both 1200 and 2400 baud rates are supported as well as auto answer, dialling and disconnect. You will find it compatible with all popular communication software.

Free Software. With each modem you will receive the QL2 Fax/modem software featuring both pull-down and mouse support.

New From ALTRONICS

D 1590 **$349.00**

Passive Infra-Red Lite Aide Floodlight Control



How often have you thought there could be a prowler outside your door? Install a Lite Aide and (once armed) any "guest" will be floodlit when detected by this highly sensitive Infra-Red Detector. The Light Aide detects a moving person or vehicle by comparing the background temperature with a rapid change of temperature across the detection beams. So when Lite Aide detects movement across the coverage area, it will turn on the floodlight(s) for 10 seconds to 15 minutes as pre-adjusted.

S 5350 **$49.95**

Cheap Security!

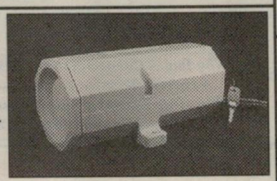
High-Tech Remote Car Alarm

This amazing model features just about everything you could imagine! Multi-function keyring remote control will arm and disarm alarm (and activate central locking if fitted), chirp the horn, turn on the car headlights, panic and even open the boot (if actuator fitted). One remote can control two alarms (in two cars). Other features include starter inhibit, valet mode, central locking interface, flashes car indicators when tripped, auto reset, user programmable options plus much more.

S 5230 Normally $249.00

This Month Only $229.95

Satellite Siren



Connects easily into most car or house alarm systems. This self contained compact unit delivers a massive 120dB of deafening sound pressure once activated. It connects simply via 3 wires to any alarm system (car or house) that has an output that is normally negative (or low). When the alarm system is activated and the output goes positive (or high) the siren will sound. The siren will also operate if the wires to it are cut. Hence it adds extra security to your system if someone tampers with it to disable it. Simply armed and disarmed via inbuilt key switch.

S 5235 Normally $69.95

This Month Only $59.95

13.8V 1A UPS

Designed for critical applications where it is important that products remain operational during mains failure, this UPS (Uninterruptible Power Supply) will supply 12V at 1.2 Amps via its internal inbuilt sealed lead acid battery even when the mains has failed. Ideal for use with alarm systems etc.

M 9090 **$69.95**

6.5" Carbon Fibre Woofer

Bargain!

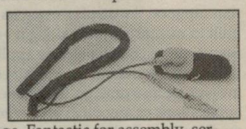
A lightweight cone helps to produce a more accurate reproduction of the signal. These drivers also use a kapton voice coil which dissipates heat faster than conventional speakers.

Rated Power .....30W RMS
Impedance .....8 ohm
RES Frequency .65Hz
Sensitivity 97dB/W (0.5m)

C 3034 NORMALLY $82.55

This Month Only $59.95

Anti-Static Wrist Strap

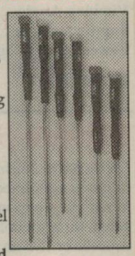


Velcro adjustable wrist strap allows full freedom of movement while protecting components from static damage. Fantastic for assembly, service work and enthusiasts alike!

New From ALTRONICS

T 4001 **$14.50**

6 Piece Screwdriver Set



Includes 3 flat blades and 3 cross head screwdrivers. The screwdrivers have long shafts which make them ideal for reaching recessed screws. Handles are made from moulded plastic, and incorporate finger grips. Shafts are made from nickel chrome molybdenum.

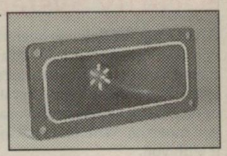
Sizes Included for Flat and Cross Blade Types:
2.4 x 75mm 3.0 x 100mm 3.8 x 150mm

T 2195 **$9.90**

New From ALTRONICS

ALTRONICS 1993 RETAIL CATALOGUE
If you haven't received yours call us on 008 999 007 for your free copy!

Rectangular Piezo Tweeter

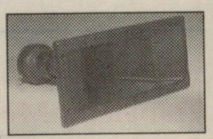


Outside diameter size of 144mm x 67mm. Rated to 15 Watts. Clearout

C 6120 NORMALLY $19.50

This Month Only $10.00

Motorola KSN1151A/1142A



Horn part no. KSN1151A, driver part no. KSN1142A. Piezo Horn speaker suited to Hi Fi, PA and sound reinforcement. With built-in protection.

Dimensions:.....265 x 110mm
Frequency Response: ....1.8kHz - 30kHz
SPL:.....92dB (2.83V/1m)
Rated Power Input: .....75w nom, 400w max

C 6155 **$90.00**

Fans

Fantastic computer type fans for replacement or additions for extra cooling of power supplies, amps etc.

F 1020 240V 80mm² **$25.50**
F 1030 240V 120mm² **$25.40**
F 1040 24V DC 120mm² **$23.90**
F 1050 12V DC 80mm² **$17.50**

ALTRONIC COMPONENTS

PHONE ORDER - FREECALL 008 999 007

ALTRONIC COMPONENTS

Alphanumeric Dot Matrix LCD Module

This compact LCD module has 96 inbuilt ASCII characters and 92 special letters which can be displayed on a 16 character by 2 line screen. The module will hold the current input on the display using its own built in memory, thus making it very easy to drive. Some possible applications could be within fax machines, measuring instruments, telephone applications or any other area where machine user feedback is required.

Specifications
Module Size: .....84 x 44 x 9.7mm
Display Size: .....61 x 15.8mm
Character Size: .....2.96 x 5.66mm
Contrast Ratio: 10
Number of Characters: ..16 Characters by 2 lines
Viewing Angle: .....Between 50 -80 Longitudinal 60 - 120 Lateral
Supply Voltage: .....5V DC
Power Supply Current: .1mA Typical

This Module can be Programmed for Personalised Messages for Your Car, Alarm System etc. etc.

Z 7299 **$35.00**

New From ALTRONICS

Micron Sure Shot Desoldering Tool

Exclusive to Altronics in Australia. This stand alone, fully self-contained desoldering tool makes it a breeze to remove components from any PCB. Even double sided, through hole plated boards. All it needs is a squeeze or two on the trigger and the component virtually falls out. **Features:** • Totally self contained • Light and compact • Anti static tip • Easy to use • Simple to clean and maintain • Variable tip temperature. The ***Sure Shot*** generates a high speed vacuum every time the trigger is squeezed. This vacuum causes the molten solder to flow into the collection reservoir contained within the unit. Here the molten solder solidifies into small particles. With its inbuilt variable temperature control the ***Sure Shot*** is ideal for single sided, double sided and through hole plated P.C.B.'s. With just a couple of squeezes of the trigger all holes are left solder-free for easy removal of the component.

T 1270 **$349.00**

T 1272 Replacement Tip to Suit **$19.95**
T 1275 Replacement Filters to Suit **$5.95**

New From ALTRONICS

UHF Microprocessor Controlled Wireless Security System

Apart from the flawless operation of the system one of the great features is its application with rented or leased premises - let's face it, money spent on installing a wired system in your home or office, factory, etc is irrevocably lost when you move on. With this system you simply take it with you.

Complete system includes:
1 x Control Panel 1 x Passive Infra Red Detector-Transmitter 1 x Door-Window reed Switch-Transmitter 1 x Hand Held remote Control-Transmitter 1 x Horn Speaker - 10 watt-wired 1 x 240V AC adaptor 1 x 1.2Ah Back-up Battery 1 x Set of batteries for all transmitters

Why Pay A Commercial Security Firm A Fortune To Wire Your House or Office. This Fantastic System Installs In An Hour or Two And Uses No Wires

S 5240 Complete System Price Only **$679.00**

High Quality TO-3 Transistor Mounting Brackets

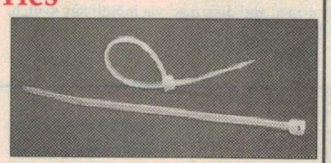
50% Off!

We have a limited quantity of these great brackets. Made from heavy duty 3mm aluminium. Pre-drilled for four TO-3 transistors and three mounting bolts. Dimensions 152w x 42d x 23h mm approx. Fantastic for power supplies, amps etc etc. Sorry Not Available from Altronic Re-Sellers

HR0595 **$6.00**

Hurry Stocks Limited!

100mm Nylon Cable Ties



H 4010 Pk 25 **$2.70**
H 4012 Pk 100 **$4.95**
H 4014 Pk 1000 **$17.95**

Up to 50% Cheaper than Competitors' Pricing, These are Very Strong and Long Lasting!

Digital Voltmeter

This well designed LCD module will take care of most of your requirements of digital voltmeter displays. Voltage range and decimal place options are easily configured by PCB links. Small, compact, reliable and comes complete with plastic surround to give a professional finish.

Specifications:
Digits: .....3.5, 13mm Height
Ranges: ....200mV, 2V, 20V, 200V, 1000V DC
Input Impedance: 10MΩ
Power Supply: .....9V DC
Over-range Indicator: .....'1'
Decimal Place: .....Variable
Accuracy: .....+/-0.5% (2 digit)

Q 0560 **$39.95**

New From ALTRONICS

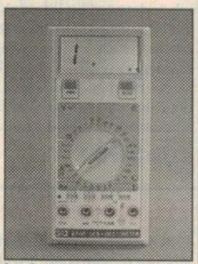
Aviation Headset

It was not to long ago when spending $450.00 on an Aviation Headset was not uncommon. Altronics changed all that when we released our C 9070 Aviation Headset for under $190.00. Since then our headset has gone from strength to strength with an enhanced microphone, improved lead shielding and headband comfort. The even better news is, our low price has not increased one cent!

C 9070 **$189.00**

1000's Sold Across Australia - Includes 2 Year Warranty!

Digital Multimeter & LCR Meter



This digital meter tests in addition to standard multimeter ranges, capacitance and inductance, enabling you to test a wide variety of components. Indispensable for the design engineer, technician and enthusiast alike.

Q 1062 **$149.00**
Q 1068 Carry Case to Suit **$12.50**

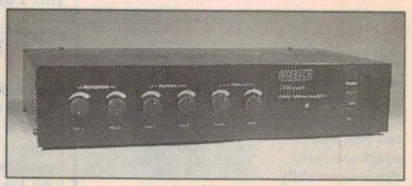
Electronic FET Multimeter

Centre zero pointer setting allows + and - readings. This meter has the advantage of digital multimeters ie. insignificant circuit loading, high accuracy etc. without the misleading and erroneous readings that DVM's are famous for. Includes AC and DC volts, resistance, AC and DC current (up to 12 amps), testleads etc etc.

Q 1050 Normally $99.50

This Month Only $89.00

REDBACK® 40 Watt Public Address Amplifier



The Redback A 2003 40W Amplifier has been designed to withstand the rigours of continuous everyday use. Ideally suited for paging and background music installations in offices, churches, halls, auditoriums, shopping centres, fast foods outlets, factories, etc.

The amplifier is suitable for either desk or bench top mounting or can be mounted into a standard 19" racking system with the optional A 2004 kit. Both Mic 1 and Mic 2 inputs are balanced suitable for use with 200 - 600 ohm microphones. Mic 1 is also provided with an unbalanced input socket. • Two times RCA sockets are provided for each auxiliary input, allowing for direct connection to a stereo source. Stereo channel separation is maintained and configured to mono operation internally, allowing for use of standard stereo leads. Auxiliary inputs are automatically muted when either Mic 1 or Mic 2 are operated (provided they have a PTT function) and the auxiliary source re-instated once the announcement is completed. Full performance is maintained when operated from a 24V battery source. The amplifier will produce a full 40 Watts at full load at less than 0.5% distortion, making it ideal for all general and emergency paging applications.

Features: • Latest design and technology • Wide frequency response +/- 3dB 50Hz - 15KHz • Very low noise and distortion, typically -70dB and 1% respectively • 2 microphone inputs 200-600 Ohm 5 pin din socket balanced pin 1 and 3 signal, pin 2 earth unbalanced input. Jack socket on mic 1 only • 2 auxiliary inputs 100K Ohm 200m V sensitivity for full output. 2 x RCA input socket (stereo to mono conversion) • AC/DC operation: 240V AC and 24V DC • Isolated 100V line output • Individual treble and bass tone controls • PTT muting on auxiliary inputs • Desk or rack mountable

A 2003 **$299.00**

A 2004 Rack Mounting Ears to Suit **$15.50**

New From ALTRONICS

PHONE ORDER - FREECALL 008 999 007

AUSTRALIA WIDE • Jet Express • ALTRONIC COMPONENTS

Portable Gas Soldering Iron Kit

Great for working on the boat, car, farm TV antenna or anywhere in the field. One refill lasts up to 60 minutes. Uses standard cigarette lighter butane gas. **Includes:** • Hot Blower Tip • Hot Knife Tip • Polyfoam Cutter Tip • Burner Tip
Sorry - Not Available from ALTRONIC Dealers at these Prices!

T 2470 Normally $79.95

This Month Only $64.95

Soldering Iron

• 370° C. • Fixed temperature • High efficiency patented heating element • Iron clad, chrome plated, long life interchangeable tips. Tip life expectancy is many times that of conventional plated tips. Supplied with T 2424 Tip. Energy authority approved.

T 2420 $27.95

Desolder Bulbs

De-Solders with an easy squeeze!

T 1245 NORMALLY $4.95

This Month Only $3.00

Palm-Grip Series Hand Tools

A must for all tool boxes. Handy palm-grip size features spring return and stainless steel construction.

T 2710 Flat Nose Pliers
T 2720 Needle Nose Pliers
ALL NORMALLY $9.95 ea

This Month Only $7.95 ea

Audio & Video Head Cleaners

Our exciting range of head cleaners are the best we've seen and more importantly they are gentle on your heads. Why risk damaging your video or audio cassette player with inferior units.

A 9200 Audio Cassette **$3.95**

A 9310 VHS Video **$12.50**

Hole Punch Set

Cuts holes in metal up to 1.6mm (16 gauge). Set of 5 punches and tapered reamer. Punch sizes, 16mm, 18mm, 20mm, 25mm and 30mm.

T 2360 NORMALLY $97.00

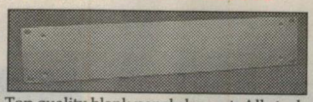
This Month Only $69.00

Stereo Headphones with Dynamic Mic

Simply brilliant Mylar stereo headsets and dynamic mic combination. Includes 3.5mm stereo plug for the earphones and a 3.5mm plug for the microphone. Great for hands-free dictation, intercoms etc.

C 9055 $49.95

Blank Rack Panels



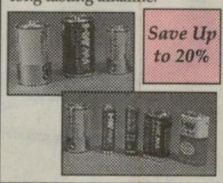
Top quality blank panel clearout. All stock must go at these crazy prices. Stock is limited with definitely no backorders. at these crazy prices.

2 Unit-All $8.00 — **3 Unit-ALL $12.95**

H 0422 Nat Alum — **H 0423** Nat Alum
H 0432 Grey — **H 0433** Grey

Assorted Battery Bargain

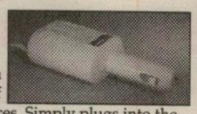
Be quick for this amazing battery special. All discontinued stock must go. Three types available - standard zinc chloride, 99.9% mercury free and long lasting alkaline.



Save Up to 20%

Cat No.	Size & Type	Pack	Was	NOW
S 4920	AA Zinc Chloride	Pk4	$2.50	$2.00
S 4930	AAA Zinc Chloride	Pk4	$2.50	$2.00
S 4940	9V Zinc Chloride Pk2	Pk2	$2.50	$2.00
S 4921	AA Mercury Free	Pk4	$1.80	$1.50
S 4931	AAA Mercury Free	Pk4	$1.55	$1.40
S 4933	C Mercury Free	Pk2	$1.60	$1.45
S 4935	D Mercury Free	Pk2	$2.10	$1.90
S 4941	9V Mercury Free	Pk2	$1.25	$1.15
S 4960	C Alkaline	Pk2	$4.95	$4.50
S 4950	D Alkaline	Pk2	$5.95	$5.45

Car Adaptor DC-DC

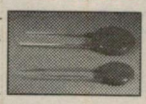


This handy multi-voltage, switch selectable adaptor enables you to run a fantastic array of DC operated devices. Simply plugs into the cigarette lighter socket. Comes complete with 2m lead and universal star adaptor to suit most appliances.

Output Voltages: 3, 4.5, 6, 7.5, 9, 12V
Output Current: 800mA

M 8150 $16.95

Metal Oxide Varistors

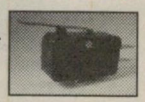


Varistors are used as protection devices. When its rated value is exceeded by a voltage spike or transient, as produced by lightning of back EMF from large motors etc its resistance changes from a very high to a very low value thus clamping the dangerous high spike to a safe level.

	Disc Size	Voltage RMS	Peak Current	Joules	Diss.
R 4110	14mm	275V	4500A	75	0.6W
R 4120	20mm	275V	6500A	140	1.0W
R 4130	14mm	130V	4500A	35	0.6W

All $2.95 ea

Micro Switch with Lever



Includes 27mm lever actuator. 6A at 250V AC. SPDT.

S 3260 $2.95

Switches

SPST chassis mount. With built in 240V AC Neon light.

S 3218 .95¢ ea

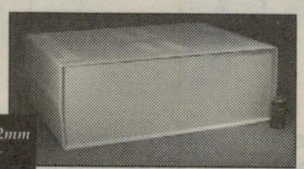
PCB Mount Terminal Blocks

Just the shot for wire termination to PCB for your latest project. Enables easy connection (and disconnection) of wire and cables to a PCB. 45° type. Available in 2 and 3 way configurations.

P 2042 2 Way WAS .60¢, NOW ONLY **.30¢ ea**
P 2043 3 Way WAS .85¢, NOW ONLY **.45¢ ea**

Super Large Instrument Cases

Designed to house amplifiers, inverters, power supplies micro-processor equipment etc. Built-in mounting posts for PCB's, transformers etc. Ventilated for efficient air-flow cooling. Extra tough, Super finish front and rear panels. 3 colours available.
Pictured battery for size comparison only.



Massive 355x250x122mm Fantastic for Power Supplies/Amps etc.

H 0490 Case **$29.95**

ALTRONICS

174 Roe St. Perth W.A. 6000
Phone (09) 328 1599, **Fax** (09) 328 4459
MAIL ORDERS C/- P.O. Box 8350
Stirling Street, PERTH W.A. 6849

STANDARD DELIVERY & PACKING CHARGE $3.50 to 500gms, $5.50 500gms -1 kg, $8 1kg-5kg **AUSTRALIA WIDE**-We process your order the day received and despatch via. Australia Post. Allow approx 9 days from day you post order to when you receive goods.

OVERNIGHT JETSERVICE Up to 3kg is $10.00, 3kg to 5kg is $23.00—We try to process your order the day received and despatch via. **Overnight Jetservice Courier** for delivery next day Country areas please allow additional 24-48 hours.

HEAVY HEAVY SERVICE-All orders of 10kgs or more must travel Express Road—Please allow 7 days for delivery. $12.00 to 10kgs. $15.00 over 10kgs.

INSURANCE-As with virtually every other Australian supplier, we send goods at consignee's risk. Should you require comprehensive insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance".

TOLL FREE PHONE ORDER-Bankcard, Visa, Mastercard Holders can phone order toll free up to 4pm Eastern Standard Time. Remember with our Overnight Jetservice we deliver next day.

ALTRONICS RESELLERS Chances are there is an Altronic Reseller right near you—check this list or phone us for details of the nearest dealer. Blue Ribbon Dealers are highlighted with a ● These dealers generally carry a comprehensive range of Altronic products and kits or will order any required item for you.

WA - COUNTRY

ALBANY	BP Electronics ●	(098) 412681
	Micro Electronics	(098) 412077
BUNBURY	Micro Electronics	(097) 216222
ESPERANCE	Esperance Comm.	(090) 713344
MANDURAH	Lance Rock Retravision	(09) 535 1246
PORT HEDLAND	Ivan Tomek Electronics	(091) 732531
ROCKINGHAM	TV Joe's	(09) 5271806

NT

ALICE SPRINGS	Farmer Electronics	(089) 522388
DARWIN	Ventronics	(089) 853 622

VIC - CITY

	All Electronic Comp.	(03) 6623506
	TECS	(03) 6706474
BORONIA	Ray Cross Electronics ●	(03) 7622422
CHELTENHAM	Talking Electronics	(03) 5842386
COLLINGWOOD	Truscott Electronics ●	(03) 4198208
CROYDON	Truscott Electronics ●	(03) 7233860
FOOTSCRAY	G.B. Telespares	(03) 3266035
PRESTON	Preston Electronics ●	(03) 4840191

COUNTRY

BAIRNSDALE	LH & LM Crawford	(051) 525677
BALLARAT	Ballarat Electronics	(053) 311947
MILDURA	Pullman Auto	(050) 232882
SHEPPARTON	Andrew Guyatt Elect.	(058) 219497
WARRNAMBOOL	Koroit Electronics	(055) 627 417

QLD - CITY

	Delsound PL	(07) 8396155
WEST END	B.A.S. Audiotronics	(07) 8447566
WOODRIDGE	David Hall Elect.●	(07) 8082777

COUNTRY

GLADSTONE	Gladstone Elect. Services	(079) 724459
	Electronic Enterprises	(079) 726660
MAROOCHYDORE	Mals Electronics ●	(074) 436119
TOWNSVILLE	Super Solex ●	(077) 724466

SA - CITY

	Force Electronics ●	(08) 2125505
BRIGHTON	Force Electronics ●	(08) 3770512
CHRISTIES BEACH	Force Electronics ●	(08) 3823366
FINDON	Force Electronics ●	(08) 3471188
HOLDEN HILL	Force Electronics ●	(08) 2617088
LONSDALE	Force Electronics ●	(08) 3260901
ENFIELD	Aztronics ●	(08) 3496340

COUNTRY

WHYALLA	Eyre Electronics	(086) 454764

TAS

HOBART	George Harvey ●	(002) 342233
LAUNCESTON	George Harvey ●	(003) 316533

NSW - CITY

	A-One Electronics	(02) 2674819
	David Reid Elect. ●	(02) 2671385
SMITHFIELD	Chantronics	(02) 6097218

COUNTRY

COFFS HARBOUR	Coffs Habour Elect.	(066) 525684
NEWCASTLE	Novocastrian Elect.Supplies	(049) 621358
WARNERS BAY	Vilec Distributors	(049) 566792
WINDSOR	M & E Elect. and Comm.	(045) 775935
WOLLONGONG	Newtek Electronics ●	(042) 271620
	Vimcom Electronics	(042) 284400
WOY WOY	Alphatran Electronics	(043) 434919

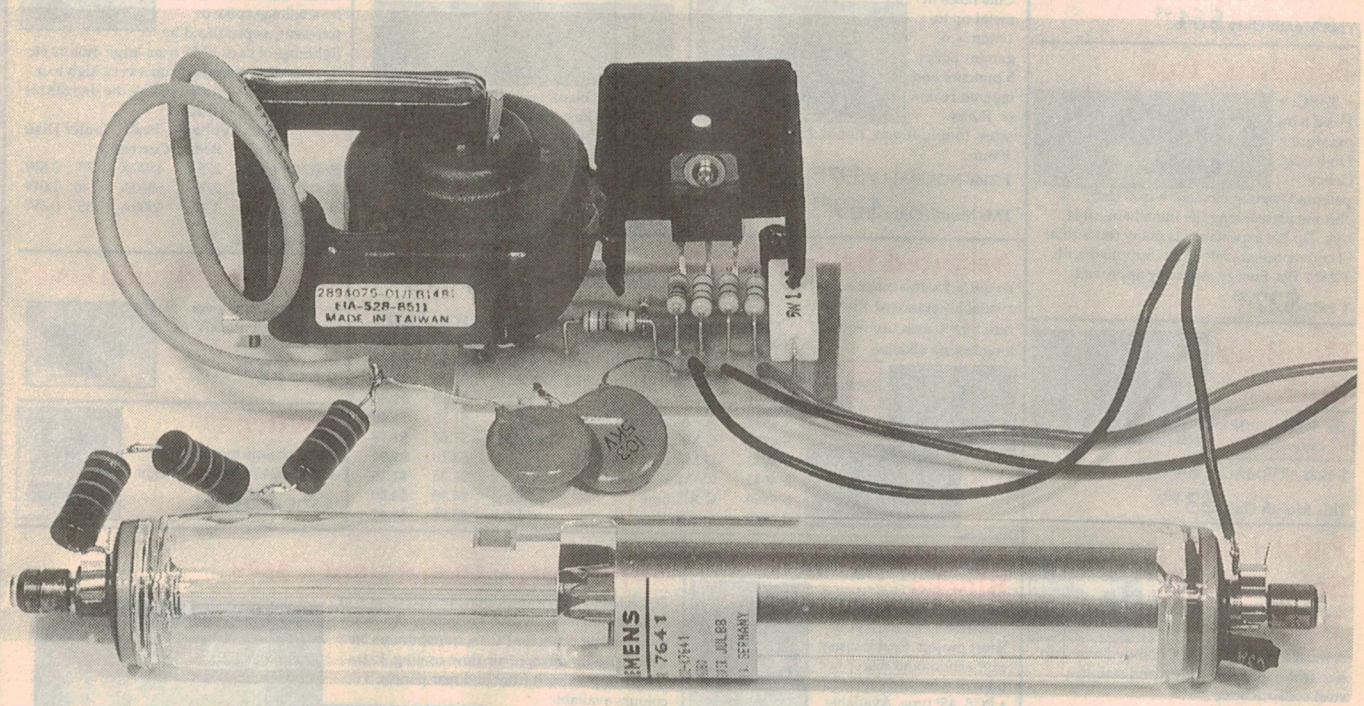
ALTRONIC COMPONENTS

PHONE ORDER - FREECALL 008 999 007

For experimenters:

'El-Cheapo' laser kit

Oatley Electronics has released a new 'El-Cheapo' laser kit, which includes a used 1mW He-Ne laser, plus a kit to build a suitable EHT supply (around 11kV) to drive it — at a very reasonable price. This means that you can experiment with lasers without seriously depleting your bank balance! As well as driving a laser, the EHT supply can also be used as a replacement for valve equipment, CROs, etc.



The EHT power supply in the background is capable of producing a peak voltage of 11kV, which is delivered to the laser tube through three ballast resistors. The two 10nF 5kV smoothing capacitors, connected in series, are shown in the centre of the photo.

Most people are fascinated by laser beams — mainly, I believe, because its beam appears so totally different to the natural light around us. To see a beam so definitely made up of one colour only (monochromatic light), and with its coherent light (all its photons in phase) so well collimated that its beam appears to go on forever — who could not help but be fascinated.

However, you would normally assume that such an exotic light source would be too expensive for an experimenter to purchase. Now, Oatley Electronics' $50 kit means that this is no longer the case.

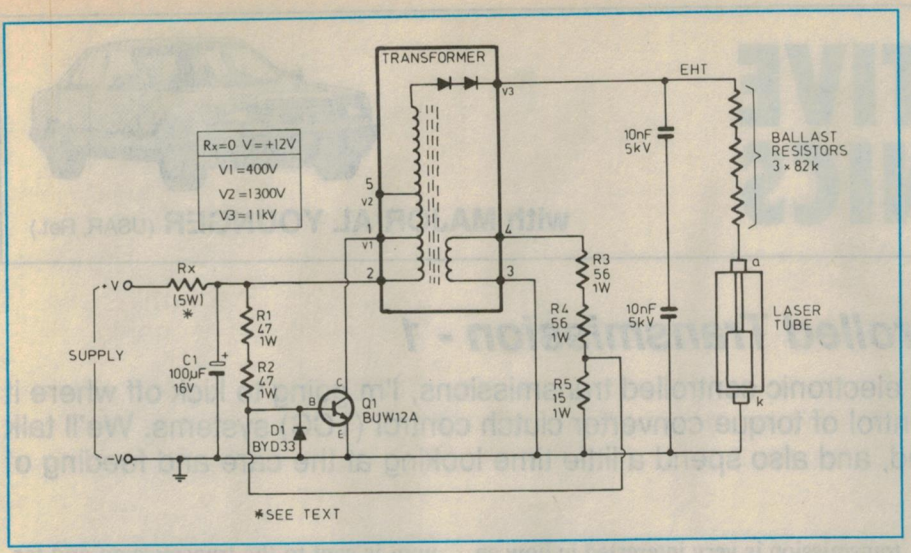
The EHT generator needed to power the laser tube consists of a flyback transformer and a handful of electronic components. When connected to a 12V, 1A power supply, it delivers a pulsed output with a maximum peak voltage of 11kV. The unit has an EHT diode rectifier (actually, many diodes in series, with a 3-5V forward voltage drop) moulded right into the transformer.

Hence the pulsed output. If required, the kit can deliver an 11kV DC output, by adding a suitable EHT storage capacitor. Also, there are several taps on the transformer, which give access to other voltages in the HT range. For example, from a fixed 12V supply, the voltages obtainable are 400V, 1300V and 11kV. To use the lower outputs, you would need to add a suitable diode and capacitor at pins 1 and/or 5.

Possible uses for this supply include experimentation, replacement supplies in servicing (e.g., old radios, CROs), plasma displays/balls, voltage breakdown testing, etc. By adding a few extra components, the EHT supply can also be used to power He-Ne laser tubes with a power rating in the 0.2 to 2mW range.

The complete generator kit and laser tube are both supplied in the 'El-Cheapo Laser' kit. You only need to assemble the kit, and power it from a 12V DC, 1A supply to get it going. For portable operation, NiCad batteries are recommended as being the most suitable, followed by lead-acid 'gel' batteries.

We have reproduced the schematic diagram to show how the circuit works. Note the input resistor Rx. Its purpose is to reduce the supply voltage and hence limit the output current to the laser. This allows control of the current, for different laser models and different powerpack voltages. Taking an example from the supplied data sheet: with a link instead of Rx and an external supply of 1.25A at 12V, the EHT generator will send a



The schematic diagram shows how the flyback transformer is connected to produce the very high output laser voltage V3. Lower voltage taps (V1 and V2) exist at connections 1 and 5.

3.4mA current to the laser. With Rx = 1.8 ohms, this current is reduced to 2.4mA. The laser current should be in the range 2.2 - 4.5mA, though the recommended maximum and minimum values will vary, depending on the length of the laser tube.

Some extra components are needed to make the generator suitable to power the laser. These are the three 82k series ballast resistors, and the two high voltage 10nF capacitors connected across these resistors and the laser tube.

Safety

Of course, it cannot be stressed enough that dealing with such high voltages as 11kV can be potentially lethal. Our photo shows the working laser with its wiring exposed — this was done *only* for photographing, and the unit was treated with the utmost caution. And if an EHT storage capacitor is added to give a DC voltage, then remember to discharge this capacitor after use.

Constructors should enclose the supply and laser inside a protective box, so that no exposed part can accidentally be touched. (You only need a small hole to allow the laser beam to shine out of the box.) The negative supply terminal should also be earthed.

Then, there are the added precautions necessary when dealing with the laser itself. The beam should never be looked at directly, or even when reflected off a shiny surface.

Despite its low power, the laser beam is made of *monochromatic, coherent* light — all its photons have the same wavelength and are exactly in phase — which makes the beam far more intense than normal light. So your finished laser should carry warning labels, relating both to 'Laser light' and 'High voltage', to alert everyone to the potential dangers.

How it performed

Considering its low price, the laser performed very well. The colourful beam immediately sprang to life when power was applied, and was used to illuminate distant objects, to inspect the plaster dots on the wall, and to form those intriguing interference patterns.

We measured its operating potential by using a 1000:1 high voltage probe connected to a DDM. At the anode of the tube the voltage was 1.1kV, while at the EHT terminal it was 1.8kV. The open circuit voltage measured 4.2kV. When viewed on the oscilloscope, the generator output consisted of very sharp peaks with a 10kHz frequency and a mark-to-space ratio of 1:10.

This explains why the measured value of the output voltage was less than the quoted 11kV. Our high tension probe was, of course, measuring the average voltage and not its peak value — and our EHT generator circuit also included an input resistance (Rx) of 1 ohm. The output voltage was certainly high enough to operate the laser very effectively.

When the power was switched off, the EHT (1.8kV) took about 20s to drop to 10% of its operating value (180V), then a further 20s to reach 1% (18V). The small high voltage capacitors (with their total value of 5nF) discharge fairly quickly through the ballast resistors and laser. Hence there is no danger in handling the unit a short time after turn-off.

When in use, the laser beam did spread out more than we expected — the 'dot' measured about 15mm in diameter, 5m away from the source. But, considering that the laser tube is only 240mm long, then this isn't really surprising.

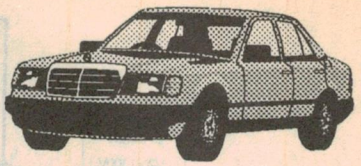
You can use the laser to experiment with many of the optical properties of light: reflection and refraction, interference patterns, total internal reflection along optical fibres, etc. Single and double slit diffraction patterns can be made by shining the beam across a sharp edge or through razor blade cuts along a blackened piece of film. (The double slit can be made by holding two razor blades together to give two closely spaced slits.)

Because of the pulsed nature of the EHT generator, you cannot easily modulate the laser beam to carry information by altering the power supply current. However, it could be possible to modulate the current flowing to the laser tube using a suitable audio transformer, capable of handling several milliamps at high voltage.

So there are many areas of experimentation to keep you fascinated with your laser. This is especially so, considering the low price of this kit.

The full laser kit, as reviewed, is available for $50 from Oatley Electronics, 5 Lansdowne Parade, Oatley 2223; phone (02) 579 4985, fax 570 7910. The EHT generator kit, including PCB, all components and instructions, is also available as a separate item for $23. (P.M.) ❖

AUTOMOTIVE ELECTRONICS



with MAJOR AL YOUNGER (USAR, Ret.)

The Electronic Controlled Transmission - 1

In discussing the ins and outs of electronic controlled transmissions, I'm going to kick off where it all started: with the electronic control of torque converter clutch control (TCC) systems. We'll talk about how this was accomplished, and also spend a little time looking at the care and feeding of an automatic transmission.

A modern car's automatic transmission is coupled to the engine by a torque converter (see Fig.1, which has an arrow pointing to the torque converter). The torque converter is akin to a fluid coupler; however it has coupling losses.

To overcome these losses, many manufacturers incorporated a clutch inside the converter (Fig.2 shows the 'Lock-Up' converter). When the clutch is engaged, the transmission is now directly coupled to the engine. This squeezes more fuel economy out of cars with automatic transmissions.

Transmission basics

Now before we run off chasing electrons through your transmission's control system, let's look at the way an automatic transmission works — in very general terms.

In my previous articles on engines, we looked at how an engine works. The transmission is very interested in how an engine works, because it is but a slave to the engine. It must monitor the engine, and reacts to its needs and commands.

Yes, the transmission is indeed a slave; it receives information from the engine, processes it and reacts accordingly. Processes it, you query? Yes — every automatic, whether it's electronic or not, has a processor. It is called the **valve body** (Fig.3).

The valve body is a *hydraulic* processor, which reacts to input information (engine and control data), then starts shifting. If it fails, well of course that's another story. Like any other type of processor, they can drive one to the edge — in more ways than one!

The information sent to the transmission is engine loading, under all conditions. Let's see how it's sent to the transmission.

1. VACUUM CONTROL: Engine vacuum is sent to the transmission and terminated on a device known as a vacuum modulator (see Fig.4). The modulator is a simple device, with a diaphragm that moves a valve, proportional to the vacuum applied.

Now remember that the engine vacuum is a measure of engine load. If you do a 'WOT' (wide open throttle), the vacuum goes towards zero (low). The other end of the scale is when the engine is idling, with a high vacuum.

Now if your engine is not in good nick, the transmission will be receiving bad information. (Sound familiar? It's the old 'garbage in-garbage out', just like any other processor!). So the most common causes for poor transmission performance are poor engine tune and vacuum leaks — most often the later. If you have a car with a vacuum-controlled transmission, *think VACUUM!*

2. TV (throttle valve) CONTROL: This is a *mechanical* monitor of engine load. It may take the form of a rod or a cable (Fig.5), one end of which is attached to the transmission. The other is simply attached to the carburettor or throttle body arm.

Your accelerator pedal also moves a rod or cable (the throttle control), which is also attached to the carburettor or throttle body arm. So as the accelerator pedal is moved, so does the TV cable, which has the other end attached to the transmission. A wide-open throttle here moves a valve in the transmission, and the valve body reacts accordingly.

So if your car has a TV cable for shifting, you don't have to worry about vacuum? WRONG! This method assumes that the engine vacuum is correct. It also assumes the rod or cable has the right adjustment, because the length of it determines shift points and pressure. So poor engine performance can still cause poor transmission performance.

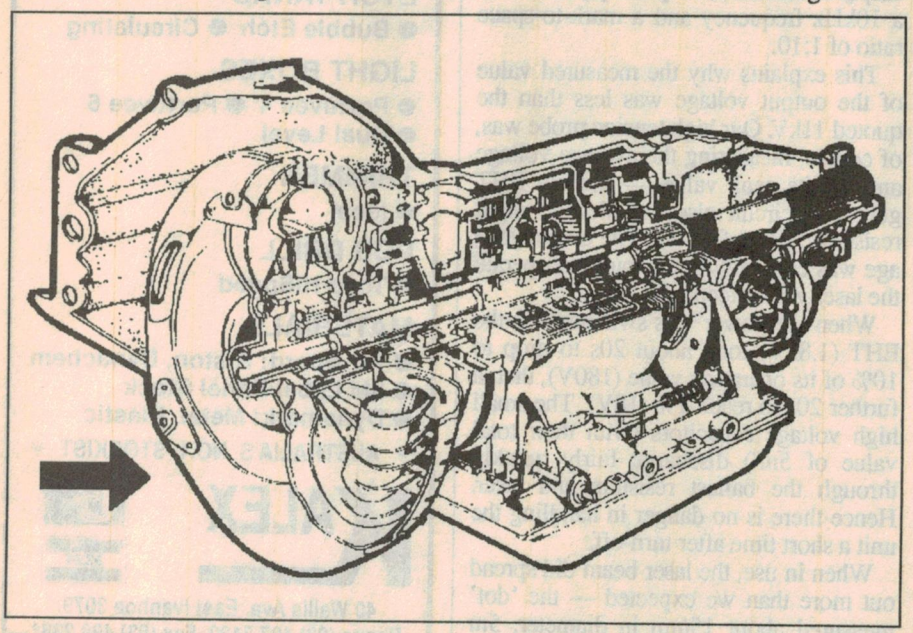


Fig.1: A typical automatic transmission, with the torque converter indicated.

Lock-up conditions

The first electrical attempts at lock-up were controlled by vacuum and thermal switches. The conditions however, were the same: when the auto transmission is at 'cruise' (i.e., transmission in top gear), with the vehicle at a more or less constant speed and the correct temperatures.

The vacuum/thermal switch system worked, but was not too responsive. By the way, before they 'got it right', Detroit lost millions on the 'lock-up' transmissions.

To provide better control, the on-board computer (let's call it an ECU as before, standing for 'electronic control unit') was fitted with a solenoid driver circuit. This circuit would energise the lock-up solenoid, when the correct conditions were met. This required the following inputs:

1. Engine temperature — via the CTS (coolant temperature sensor);
2. Vehicle speed — via the VSS (vehicle speed sensor);
3. Throttle opening — via the TPS (throttle position sensor);
4. Engine Load — via the VS (vacuum sensor) or MAP (manifold absolute pressure) sensor;
5. Braking — via the BS (brake switch). Some systems used other means for monitoring braking or deceleration, to unlock the clutch; and
6. Gear Apply — some systems monitored transmission gear apply and even transmission sump temperature, through switches. This lets the ECU know what gear the transmission is in and that it is ready for lock-up.

Hydraulic lock-up

With a hydraulic lock-up system the 'clutch' consists of the *converter housing cover* (see the lock-up converter in Fig.2), which has friction material on the inside, and the *pressure plate*, which is splined to the turbine hub. The stator shaft is hollow (see the turbine shaft in Fig.6), and runs through the converter (right to left, not shown in Fig.2).

The pressure plate, splined to the turbine assembly hub, freely rotates. When lock-up is signalled, a fluid path is opened. The fluid drains through the hollow turbine shaft, which lowers the pressure on the front side (left) of the pressure plate. The pressure on the rear side (right) of the pressure plate therefore moves it (left), to contact the converter housing cover. This locks the turbine assembly, the pressure plate and the converter housing cover together, and they are now directly coupled to the engine and rotating at engine RPM.

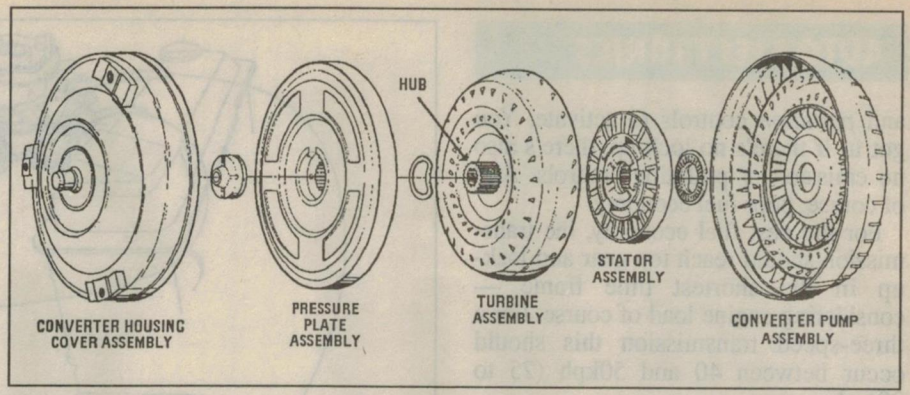


Fig.2: An exploded view of a 'lock-up' torque converter, showing its construction.

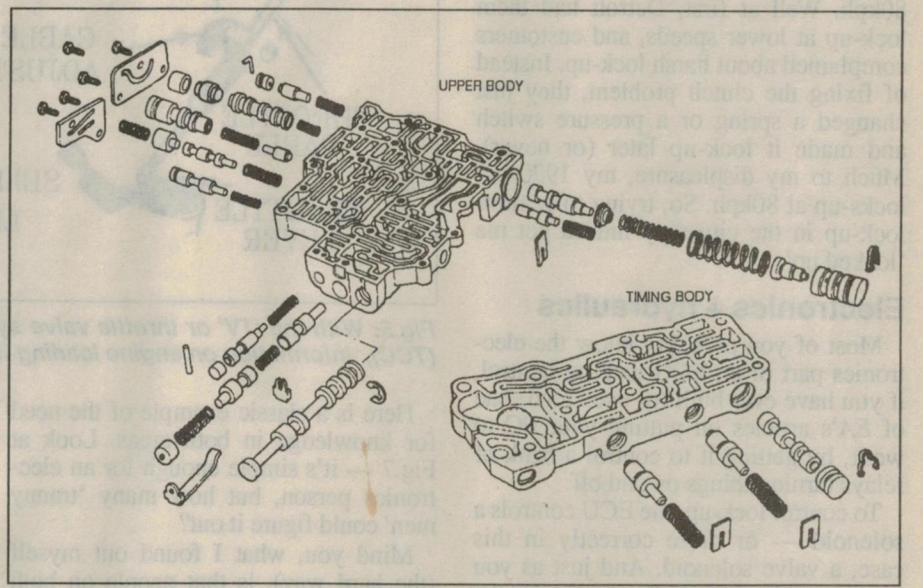


Fig.3: It may not look like the kind of processor that you're familiar with, but it does a similar job. It's the transmission's 'valve body' — a hydraulic processor.

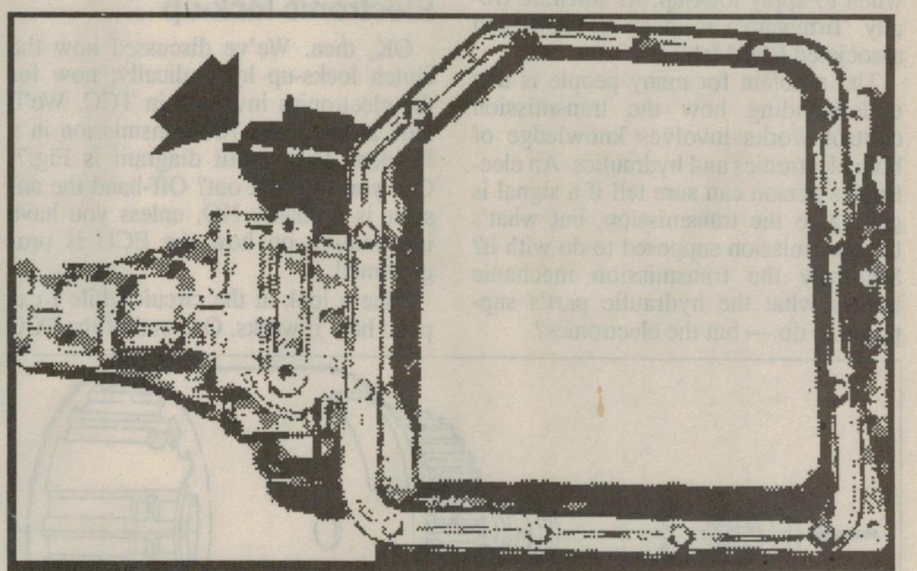


Fig.4: Engine vacuum is sent to the transmission via the vacuum modulator, indicated here by the arrow at upper left.

Generally speaking, most three-speed automatics lock-up in third gear. The four-speeds may lock-up in third or fourth. Another point of importance, in many systems, is that when lock-up occurs, the ECU signals for the *emission*

and *pollution* controls to activate. You got it: if there's no lock-up, there's also no emission or pollution controls. And of course, poor fuel economy.

For the best fuel economy, the transmission should reach top gear and lock-up in the shortest time frame — considering engine load of course. For a three-speed transmission this should occur between 40 and 50kph (25 to 30mph).

Yes, I know — yours locks-up at 80kph. Well at first, Detroit had them lock-up at lower speeds, and customers complained about harsh lock-up. Instead of fixing the clutch problem, they just changed a spring or a pressure switch and made it lock-up later (or never). Much to my displeasure, my 1990 car locks-up at 80kph. So, trying to achieve lock-up in the city may indeed get me 'locked up'.

Electronics + hydraulics

Most of you probably know the electronics part of an ECU lock-up control, if you have ever built (or even read) one of *EA*'s articles on putting your PC to work, by getting it to control a bank of relays turning things on and off.

To control lock-up, the ECU controls a solenoid — or more correctly in this case, a valve solenoid. And just as you have to write your software to run the relays, the ECU has software that tells it when to apply lock-up. Its software (really 'firmware') is in an EPROM and associated ROM tables.

The problem for many people is that understanding how the transmission control works involves knowledge of both electronics and hydraulics. An electronics person can sure tell if a signal is getting to the transmission, but what's the transmission supposed to do with it? Similarly the transmission mechanic knows what the hydraulic part's supposed to do — but the electronics?

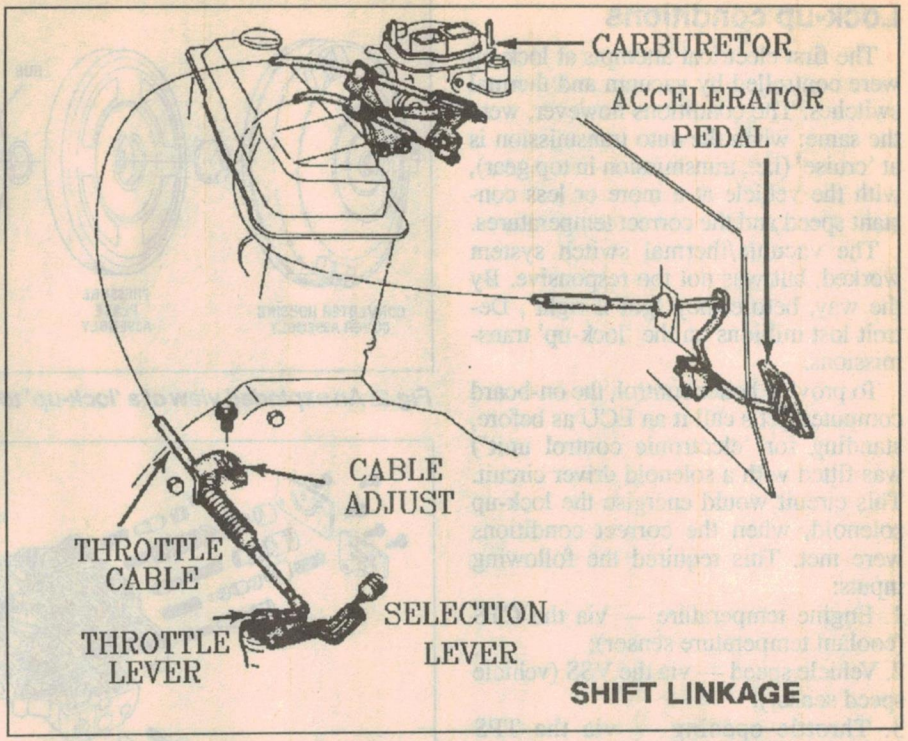


Fig.5: With the 'TV' or throttle valve system of torque converter clutch control (TCC), information on engine loading is sent by a mechanical throttle linkage.

Here is a classic example of the need for knowledge in both areas. Look at Fig.7 — it's simple enough for an electronics person, but how many 'tranny men' could figure it out?

Mind you, what I found out myself (the hard way), is that people on both sides need help. Let's see why...

Electronic lock-up

OK, then. We've discussed how the clutch locks-up hydraulically; now for the electronics involved in TCC. We'll look at the THM-700 transmission in a Holden. The circuit diagram is Fig.7. Can you figure it out? Off-hand the answer is probably NO, unless you have information on how the ECU is programmed.

Take a look at the circuit while I explain how it works. One end of the TCC solenoid is connected to the fused battery positive (+12V). The other end is connected to pin A7 of the ECU, which goes to low (negative, earth) in the active state ('looking for earth'). Now remember, we must satisfy the conditions for lock- up.

When we drive down the street at normal throttle, it shifts from first to second, then shifts to third, and then locks up (ECU pin A7 goes low, allowing the TCC solenoid to draw current). Then finally, it shifts to fourth, with the clutch still locked-up.

Now we come to a stop, so the clutch unlocks. Why — and how? The reason *why* is that if it didn't unlock, the engine would stall. How this happens is that you took your foot off the accelerator pedal, to move it to the brake. When the ECU sees less than 14% throttle opening (by monitoring the TPS), it then sends its pin A7 high — removing current from the TCC solenoid.

Now here's a problem: the circuit shows two switches (in one body), a 'transmission sump overtemp' switch and a 'fourth apply' switch, both normally open (N/O). Let's assume the transmission sump temperature exceeds 130°C, so the overtemp switch closes. We do the normal test drive, and end up in 'fourth lock-up' condition so that the 'fourth apply' switch will be closed. Everything seems OK.

Now we stop, and start off again. But

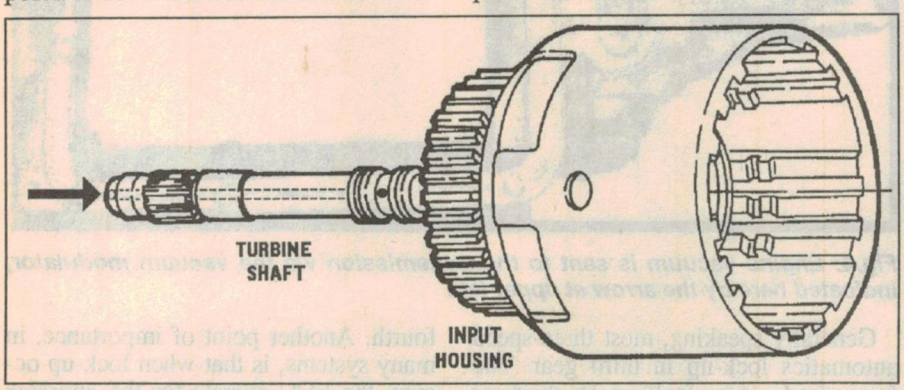


Fig.6: Fluid control of the lockup converter's clutch via the hollow stator shaft.

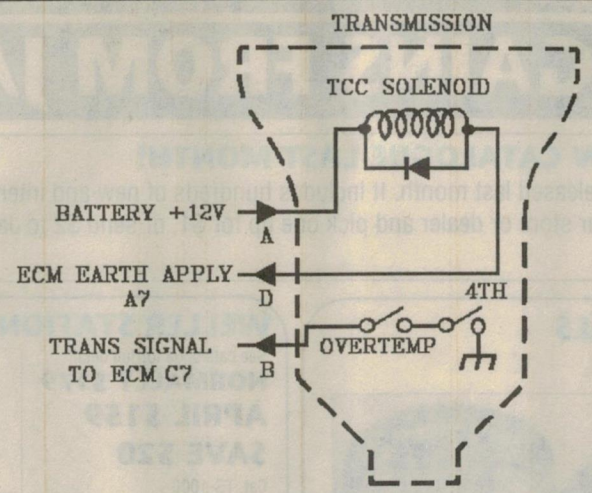


Fig.7: The electronics inside a Holden THM-700 transmission. Not exactly complex, is it — for you electronics people, anyway. But what about the hydraulics?

after the shift to second, the clutch locks up. Continuing just gets us into third lock-up, then fourth lock-up.

What's happening? The ECU has seen the overtemp condition, and is allowing lock-up in second. In second, the high engine RPM allows additional transmission cooling. (NOTE: Both switches must close.)

In this sort of a situation, the CEL (check engine light) should come on, but don't count on it. If your transmission locks-up in second, get to a transmission specialist straight away.

Does TCC lock-up work? For the intended purpose — fuel economy — it certainly does. It also reduces engine wear. When the torque converter clutch locks up, engine RPM drops, so there is less wear.

Self diagnostics

Most ECU's provide access to TCC diagnostic codes, to aid in troubleshooting should a fault occur. Some provide a diagnostic link that allows monitoring of the sensors and other data, in real time, with a data scanner.

When it comes to diagnostic codes, everyone in Detroit speaks a different language, so all the codes have different names. Let's just talk about three: 'hard', 'soft' and 'intermittent', and their general definitions.

HARD CODE: This is a fault that may endanger life or equipment. It will 'light the dash' — i.e., the CEL will come on and remain on. It may also place the system in the 'limp mode'; i.e., default mode.

SOFT CODE: This is a fault that the system has been able to correct for, but needs attention. This too will 'light the dash', but it may not place the system in default mode.

INTERMITTENT CODE: This indicates a fault that has occurred in the past. This fault will cause the CEL to stay on longer than usual, after cranking, and will blink occasionally while driving. Some systems have 'keep-alive memory' (KAM) for storing intermittent or history codes.

Care and feeding

Now if you just rely on codes to save you from having expensive transmission work, shame on you. I do not believe in the prescribed maintenance schedule in the operators handbook, since the definition of normal driving conditions is open to conjecture. Either ask your 'tranny man', or do what I do.

I change the transmission fluid once a year. The fluid is a mixture of additives, which tend to deteriorate, mostly from heat. The biggest cause of premature failure is overheating and loss of fluid. Remember, your engine radiator houses the transmission cooler. So an engine overheat problem may destroy your transmission. If you tow anything, install an additional cooler. Lowering the transmission temperature by 20° will double its life.

Check the fluid level at least once a month. Make sure you know how to check. Most transmissions have instructions on the dip stick. If the fluid is low, you have a leak. Transmissions do not use fluid like an engine uses oil. If it's low enough, once around the block will cost you a transmission.

Watch for leaks where you park your car. If a drop is spotted, reddish in colour, head to your tranny man quick! A seal job costs much less than a complete overhaul. A sign of low fluid is transmission slipping, especially when turning.

If the fluid smells or looks burnt, the transmission is burnt. If the fluid looks like a strawberry milkshake, it has water in it. If it looks like a chocolate milkshake, it's burnt and has water in it! In either case, it's overhaul time.

Next time round we'll look at 'electronic controlled' and 'electronic automatic' transmissions.

For those that are interested in transmission codes, I still have the Code Book for all engines and transmissions — send $35.00 to Major Al, PO Box 477, Double Bay, NSW 2028. My other book 'Maintaining the Electronic Motor Car' is also still available, for only $25.00. ❖

APRIL BARGAINS FROM JAYCAR

NEW CATALOGUE LAST MONTH!

The Jaycar 1993, 180 page catalogue was released last month. It includes hundreds of new and interesting products. If you haven't got your copy yet call into any Jaycar store or dealer and pick one up for $1, or send $2 to Jaycar, PO Box 185 Concord 2137, and we'll post you one.

LOWER PRICES ON TOROIDALS

Manufacturers, contact us for even better prices for quantity.

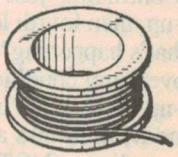
160VA
NOW $64.95
WAS $74.95
300VA
NOW $74.95
WAS $92.50

WELLER STATION REDUCED!

See catalogue for full details.
NORMALLY $179
APRIL $159
SAVE $20
Cat. TS-1000

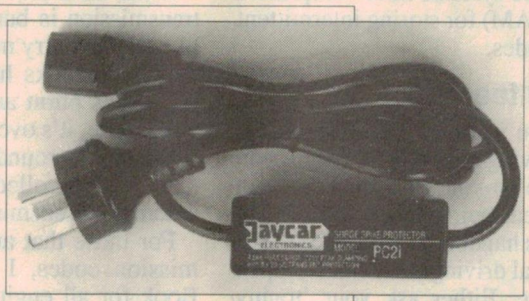
30 METRE ROLL SPEAKER CABLE

14/0.14mm twin figure 8
Cat. WB-1703
WAS $7.95
NOW $6.95 SAVE $1



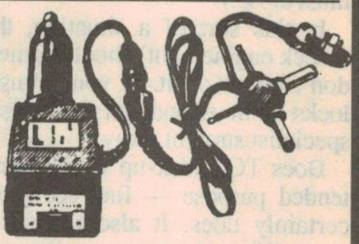
COMPUTER MAINS FILTER

Simply replace the mains lead with our IEC lead with the mains filter built-in. Will protect against surge and spikes for computers, monitors, printers, faxes, photocopiers, etc.
Cat. MS-4000
$27.95



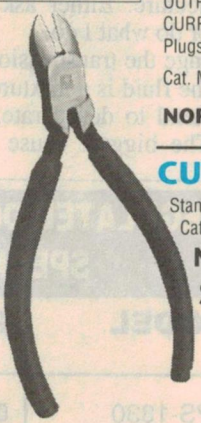
SAVE ON DC CAR CONVERTOR

INPUT 13.8V DC
OUTPUT 3, 4.5, 6, 7.5, 9, 12V
CURRENT 800mA
Plugs into cigarette lighter.
Cat. MP-3014
NORMALLY $16.95 APRIL $12.95 SAVE $4



UPGRADE YOUR MIDRANGE

Quality white cone. See catalogue. Power handling 80W rms system. Frequency response 350Hz - 5.5kHz.
Cat. CM-2080
NORMALLY $28.50 APRIL $20 SAVE $8.50

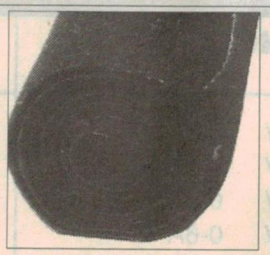


CUTTERS - 120mm

Standard cutters with captive coil spring and vinyl handles. 120mm long.
Cat. TH-1891
NORMALLY $9.95 APRIL $5.95
SAVE $4

SPEAKER CARPET

At last, now you can buy that black/grey carpet that is on all professional PA speaker bins. Up until now it's been almost impossible to buy small quantities.
We sell it in 1 metre lengths by the width of the roll which is 1860mm (6').
Cat. CF-2755 **$39.95**



10" WOOFER SENSATION

This is a quality woofer with foam roll surround, silver dust cover and grey ribbed cardboard cone. Listed below are all the specifications we have available.

Impedance	8Ω
Power Handling	60 watts
Resonant Freq. (approx)	38Hz
Frequency Response	38 - 3kHz
Suitable Enclosure	25L or more - sealed

Cat. CW-2117 **$26.95**

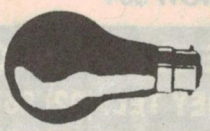
NORMALLY WORTH ABOUT $45

40W BLACKLIGHT FLUORESCENT TUBE

You've seen these in disco's, nightclubs, restuarants, shops, etc. Standard 40 watt 4 foot ultraviolet blacklight tube. Great for special effects, etc.
Cat. SL-2770 **$44.95**

BLACK LIGHT GLOBE

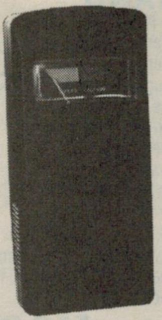
Great for parties. It's an incandescent lamp with an ultra violet coating. Will fit any 240V AC standard globe socket. Rated at 75 watts.
Cat. SL-2760 **$9.95**



TURN YOUR SURPLUS STOCK INTO CASH!

Jaycar will purchase your surplus stocks of components and equipment. We are continually on the lookout for sources of prime quality merchandise.
Call Mark Harris or Bruce Routley NOW on (02) 743 5222

MICROWAVE OVEN LEAK DETECTOR



Microwave ovens may leak very harmful high energy which will affect your health. It usually results from wear and tear on the door components, including the hinges and the seals on the door. This unit will detect these leakages. By placing the front lens of the leak detector against the seam of the oven (whilst the ovens on) and moving it slowly along the line of the seam. If the meter points to the green, there is little leakage, but if it points to the red a dangerous leak exists. Have your oven checked and repaired at once by an authorized dealer. These detectors normally sell from $20 to $25. We have them available at about half that.

Specifications
Range 0 - 10mW/cm²
Green Zone Under 5mW/cm²
Red Zone Over 5mW/cm² (danger)

NEW FOR '93

Cat. QM-7260 **$12.95**

QUALITY DISKS AT SILLY PRICES

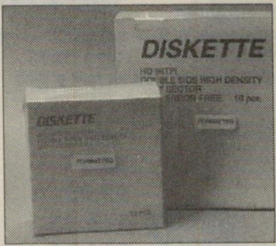
Jaycar has sold millions of disks over the last few years. Our standard white box disks have a **lifetime guarantee.**
They are supplied with envelope, index labels and write-protect tabs.
Remember, these disks might be cheap, but they are good quality, they have a **lifetime guarantee.**

5 1/4" DSDD 48TPI
DOUBLE SIDED/DOUBLE DENSITY
Cat. XC-4730 PKT 10 **$5.50**

5 1/4" DSHD 96TPI
DOUBLE SIDED/HIGH DENSITY
Cat. XC-4732 PKT 10 **$10.50**

3 1/2" MF2DD 135TPI
DOUBLE SIDED/DOUBLE DENSITY
Cat. XC-4736 PKT 10 **$10.95**

3 1/2" HIGH DENSITY DISCS
MF2HD
Cat. XC-4738 PKT 10 **$17.50**



DISKS FORMATTED TO IBM

5 1/4" High density
Cat. XC-4733 pkt 10 **$11.50**
3 1/2" High density
Cat. XC-4739 pkt 10 **$18.95**

JAYCAR BUTANE GAS

Another Jaycar brand product. We've cut out the middleman, and reduced the price. Last year a can of 150g gas cost $7.50, now Jaycar 150g gas is only $5.95.
Use it for filling up your Hot-Sol soldering iron, other brand gas soldering irons, flame torches, cigarette lighters etc. Includes five different adaptors which cover most different nozzles. Includes filling instructions.

NEW FOR '93

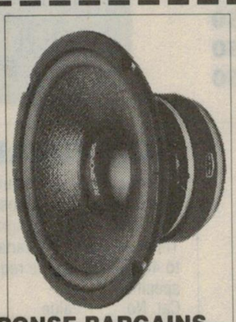
Cat. NA-1020 **$5.95**

JAYCAR DEALERS IN MANY COUNTRY AREAS

SAVE ON RESPONSE HIGH POWER SUBWOOFER KIT

See Electronics Australia January 1993
Build a 200W rms subwoofer. After the June subwoofer article which featured our 8" subwoofer, EA was beseiged with requests for a higher power unit. They have used our Re/Sponse 12" driver and we have had cabinet kits made to suit.

SPEAKER Re/Sponse 12" driver Cat. CW-2145
NORMALLY **$199 NOW $179 SAVE $20**



CABINET KIT

The cabinet is not cheap, but we found that there is an enormous amount of work for the home constructor to line up all the wood, drill and screw. Our cabinet kit is made from 18mm MDF customwood, as recommended in the article. There are 64 holes pre-drilled to fix the 32 x 50mm screws supplied and needed for strong assembly. The baffle has been routed and the T nut sockets are in place to mount the driver. There is a 50mm round hole to mount the rear terminal which is supplied. The MDF customwood is supplied in a natural state with a view to painting it.

Cat. CS-2485 **$189**

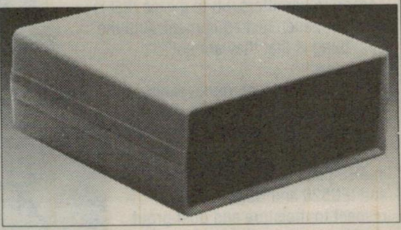
OTHER RESPONSE BARGAINS

	Cat	WAS	APRIL
6"	CW-2140	$75	$65
SAVE $10			
8"	CW-2142	$109	$90
SAVE $19			
12"	CW-2145	$199	$179
SAVE $20			

PRO QUALITY INSTRUMENT CASE *SLASHED*

This box is the largest one in the range of 3. It has been used in countless kits, including test equipment, power supplies etc., etc., etc. Grey colour, with black plastic panels. Size 260(W) x 190(D) x 80(H)mm.
Catalogue price is $20.95. We're overstocked. Stock up now at this crazy price.
Cat. HB-5910

$12.95
SAVE $8
10+ LESS 10%



NEW KIT

LOW COST 1GHz FREQUENCY COUNTER KIT

Ref: EA 4/93

NEW FOR '93

This new design by EA is based around their 50MHz version, published in Feb 1993, but offers 7 digits of resolution, and operation up to 1GHz. Without doubt, this is definately the cheapest way to get into a 1GHz counter.
The Jaycar kit is supplied complete with instrument case, professionally punched and screened front and rear panels; mains transformer; PCB and all specified components. Only the Jaycar kit is supplied with 1% metal film resistors and MKT caps throughout plus a clear red perspex lens for a more professional appearance.
Cat. KA-1750
$149.50

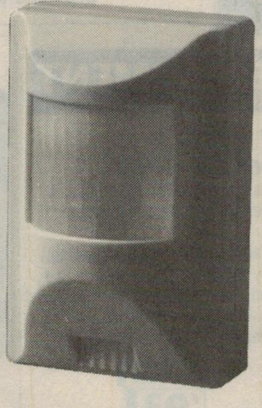
PULSE COUNT PASSIVE INFRARED DETECTOR UNDER $50 - UNBELIEVABLE!!!

Another first for Jaycar.
The Bellmate PIR is a high quality unit directly imported by Jaycar. It has pulse count triggering which up until now was only found in units of $80 or more.
The Bellmate has switchable pulse count operation with single pulse trigger and three pulse trigger. When set to three pulse the unit requires three movements before the alarm is triggered. This will virtually eliminate false alarms.

FEATURES AND SPECIFICATIONS
• Incorporates S.S.C. (slide seal chambers) • 24 element zones in 3 layers • Wide angle 90° coverage • Coverage 15 x 15 metres • Operating voltage 9 - 16V DC • Tamper switch for 24 hour zone • Pulse count switchable, normal or 3 pulse
• Sensitivity adjustment • LED indicator • Sliding PC board
• Size 110(H) x 70(W) x 55(D)mm • N.C. terminals
• 1 year warranty

Cat. LA-5016 **$49.95**

1 YEAR WARRANTY



Installers - contact us for wholesale prices

SEALED DIE-CAST ALUMINIUM BOXES

New for 1993. This range of boxes compare quality wise to those English and Canadian ones that are VERY expensive. These are ideal for housing electronic assemblies, pneumatic, hydraulic and electrical devices in commercial and industrial environments effective shielding of EMI and RFI.

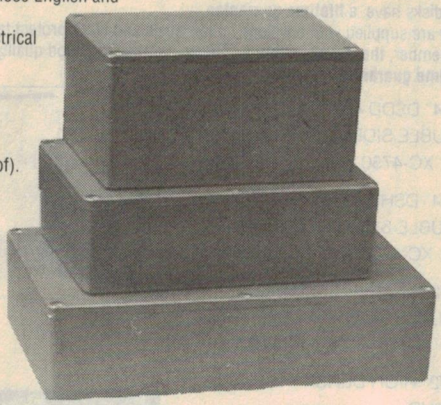
Features include:

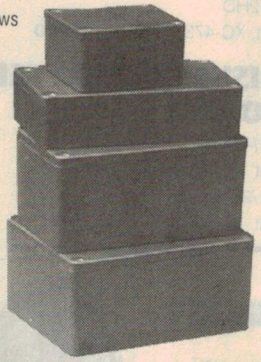
- Aluminium die-cast - resistant to atmospheric and marine corrosion.
- Designed to IP65 of IEC529 and NEMA4 (dust and hoseproof).
- Wall mounting holes and lid fixing screws are outside the sealing area.
- The lid incorporates a recessed neoprene gasket.
- Bosses on internal base for fixing PCB's horizontally or connection of earth grounding, etc.
- Internal guide slots for mounting PCB assemblies vertically
- Screw holes for lid mounting are roll threaded
- Captive, recessed lid screws

Specifications:

- Box and lid - aluminium alloy ADC-10 to Japan Industrial Standard (JIS) in natural state • Gasket - neoprene, resistant to oil and petrol • Lid screws - M4 stainless steel (non magnetic) • Ground screw and washer - copper plated.

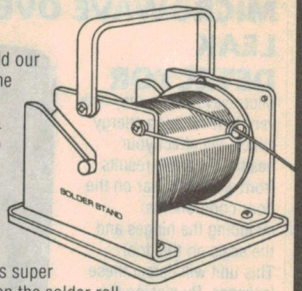
Manufacturers and bulk users - contact our wholesale department for bulk pricing.





Cat. No.	Dimensions L x W x Hmm	Wall Thickness (mm)		Price
HB-5030	64 x 58 x 35	3.5		$6.95
HB-5036	115 x 65 x 30	3.4		$9.95
HB-5040	115 x 65 x 55	3.3	NEW FOR '93	$13.95
HB-5042	115 x 90 x 55	3.3		$14.95
HB-5044	148 x 108 x 75	3.3		$26.50
HB-5046	171 x 121 x 55	3.3		$28.50
HB-5050	222 x 146 x 55	3.3		$29.50

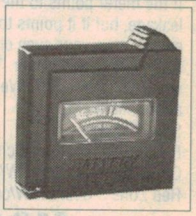
SOLDER STAND



This stand will hold our solder reels and the solder is fed through the guide. It has a handle, so it can easily be carried, and it can be wall mounted to be right there where you always need it. The base is super heavy so even when the solder roll is nearly empty it will still feed O.K. Also good for field service work.

Cat. TS-1515 **$19.95** NEW FOR '93

BATTERY TESTER

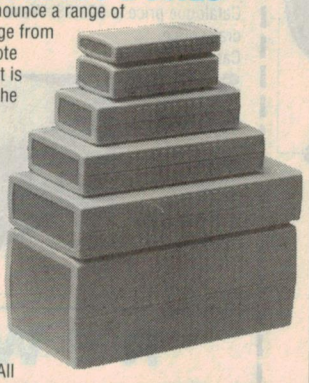


This compact unit will test all battery types from 9V and 1.5 volt to button batteries. The meter will advise if the battery needs replacing, or in the case of NiCads recharging. Loads up battery to determine charge. Incredibly compact - measures only 53 x 50 x 18mm

Cat. SB-2300 **$9.95**

HIGH QUALITY PLASTIC BOXES

New for 1993, Jaycar is proud to announce a range of high quality plastic boxes. These range from a small flat case that is ideal for remote control transmitters, up to a case that is ideal for bench test equipment. And the best thing is that they are not expensive.



All are supplied with removeable front and rear panels which are mid grey in colour, with the rest of the case light grey. They are moulded in ABS plastic, conform to IP54 and IEC529 and NEMA4 with respect to moisture and dust proof sealing.

Guide slots are provided for vertical mounting of PCBs, and spacers are moulded in for horizontal mounting. All but the smallest two have M3 screws and brass inserts to hold top and bottom together.

Cat. No.	Size L x W x Hmm	NEW FOR '93	Price
HB-6030	90 x 50 x 16		$2.95
HB-6031	90 x 50 x 24		$3.95
HB-6032	120 x 60 x 30		$5.50
HB-6034	150 x 80 x 30		$7.50
HB-6036	190 x 100 x 40		$11.95

BUY 10 LESS 10%

NON-POLARISED CROSSOVER CAPACITORS

Up until now if you required a high value (100µF up) capacitor for a crossover that will handle real power it was near impossible. Our 50V BiPolar range really are not adequate for crossovers. This new range is designed especially for crossover networks and will handle much higher power. There are too many variances to quote actual power handling. The range includes large values - up to 400µF, (which are required for subwoofers). All capacitors have RT or axial leads. Sizes as specified.

Cat. No	Value	Size (D x L)mm	Price
RY-6901	1µF	8 x 17	$1.00
RY-6902	2.2µF	8 x 17	$1.00
RY-6903	3.3µF	8 x 19	$1.00
RY-6904	4.7µF	8 x 19	$1.00
RY-6906	6.8µF	10 x 19	$1.20
RY-6908	10µF	10 x 19	$1.30
RY-6910	15µF	10 x 19	$1.50
RY-6912	22µF	10 x 24	$1.70
RY-6914	33µF	13 x 27	$2.50
RY-6916	47µF	13 x 32	$2.95
RY-6918	68µF	16 x 34	$3.50
RY-6920	100µF	16 x 34	$4.50
RY-6924	150µF	18 x 38	$6.95
RY-6928	200µF	18 x 44	$7.95
RY-6932	300µF	22 x 44	$10.95
RY-6936	400µF	22 x 44	$12.95

Jaycar will match or better the price of any product that our competitors sell, provided the goods are in stock and of the same quality.

JAYCAR FOR SUPERB TEST EQUIPMENT

JAYCAR 6.4MHZ OSCILLOSCOPE 3" CRT

5.0MHz -0dB, 6.4Mhz -3dB, 8.8MHz -6dB, 10.6MHz -10dB

Brand new 6.4MHz (-3dB) Cro for 1993. The QC-1908 is a compact, reliable, universal Cro which uses a 75mm CRT and unique lightweight metallic alloy housing. The vertical system provides a sensitivity of 10mV/div or over and a frequency bandwidth of 6.4Mhz (-3dB).

The time axis circuit provides sweep frequencies of 10Hz - 200kHz sweep, and synchronising triggering, INT, TV, Line & Ext. In internal sweep mode it provides deflection sensitivity of 300mV/div or over, and a frequency band of DC - 250kHz. It will start operating in less than 20 seconds after power on. Also featured is a 'marker input' which is useful for alignment of RF stages in TV or radio. The manual contains a maintenance and calibration section complete with circuit diagrams. Supplied with 1:1 banana plug to alligator clip leads. **See catalogue for full specifications.**

Cat QC-1908 **$379** NEW FOR '93

SHORTWAVE LISTENING

by Arthur Cushen, MBE

Alaska now on the radio map

The gospel broadcaster KNLS is now operating in Alaska under very harsh climatic conditions. The snow remains on the ground for six months of the year, and the station is faced with many engineering problems — including the high winds and icing of the towers.

A country which previously had no shortwave broadcasting service is now well received, as KNLS over the past years has provided excellent reception in the South Pacific. As we enjoy our summer weather, we can think of KNLS snowbound at Anchor Point, Alaska.

KNLS uses one 100kW shortwave transmitter from the Harris Corporation, which has proved reliable over its years of operation, despite the very changeable climate in Alaska.

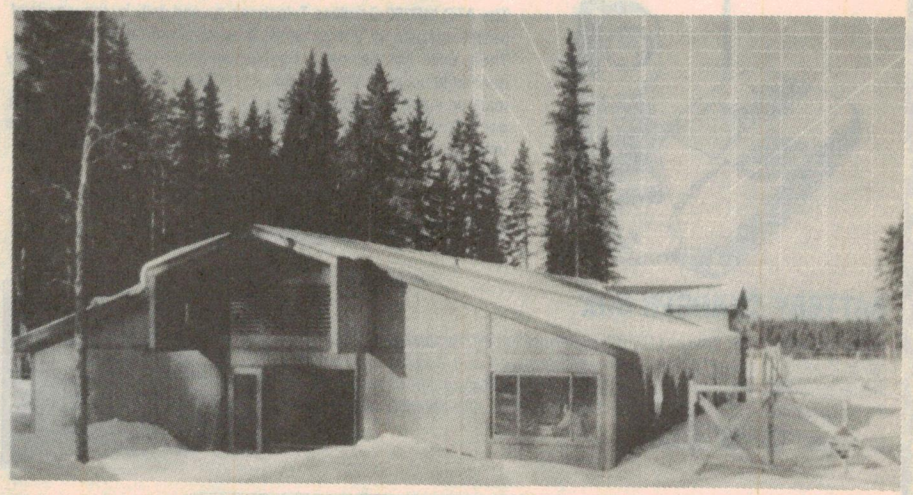
The transmitter generates a lot of heat — 65% of its energy goes to RF, while the remainder is dissipated as heat. This heat passes through ducts in the walls, which enables the whole building to be heated. The oil-fired generators which supply power to the transmitter are also used to heat the building when the transmitter is off the air.

The antenna used by KNLS is a 'curtain' dipole antenna, manufactured by TCI. It consists of 16 separate dipole antennas and is supported by two towers, each 110m high. Due to the severe winter and the icing up of the antenna, there is a counterweight of concrete blocks which comes off the ground, allowing the antenna to sag. This is a protective measure to safeguard the towers from being loaded too much.

The station has been working on an audio automatic system to relieve the manpower at the station. KNLS has two projects underway at the moment: to automate the audio source and to operate the transmitter automatically.

High winds are the main problem for KNLS, and the station, at times, has to come off the air. The climate of Alaska is extreme — the snow falls in October and remains on the ground until April, so when the snow comes, it is there to stay!

Last year, some snow did not melt until the beginning of June, and there was over one metre of snow on the ground for the entire winter. The average snowfall is 150 to 200mm at a time.



The studios and transmitting buildings of KNLS, Anchor Point, Alaska sited in one of the harshest operating areas in the world.

The summer is a complete contrast, with warm weather and light for 24 hours a day. In the winter, the sun only shines from 10am to 4pm at KNLS. (Moose are plentiful in the area, but brown bears are rare).

Anchor Point is a relatively new settlement in Alaska. It was founded some 25 years ago, and proved to be a crossroads for travellers in the area. The community hall was the first building in Anchor Point, according to Kevin Chambers the Station Manager. He says that what he likes most about Alaska is that it is a good place to raise a family; and there are a lot of things to share, especially if you like to do things outside. The only drawback is the isolation, as most of the staff have relatives in the United States.

KNLS broadcasts in English from 0800 - 0900 UTC on 9615kHz and from 1300 - 1400 on 9615kHz. This schedule is valid to September 26. KNLS also broadcasts in Russian and Mandarin to Asia. The address of the station is KNLS, PO Box 473, Anchor Point, ALASKA 99556. The call sign stands for 'New Life Station'.

It is a gospel-based broadcaster, with a considerable amount of more popular music. On Friday at 0845 listeners' letters are answered on the air. (This information came from a tape recording kindly supplied by KNLS Station Manager, Kevin Chambers).

New name, new home

Radio Beijing is now known as China Radio International, as in the past few months, a re-organisation of broadcasting in Beijing has resulted in the separation of the medium and shortwave services. Radio Beijing has become a very well known name to shortwave listeners, but it can be a source of confusion to people in the Chinese capital. Many people and departments, including the local postal service, get it mixed up with Beijing Radio, the city's local station.

Last September was a red-letter day for China Radio International as ground work was commenced for a new studio complex. The site is in Western Beijing's

AROUND THE WORLD

BRAZIL: Radio Nacional de Amazonia, Brazilia broadcasts on 6181kHz and is heard around 0830 with a continuous spoken programme. There is severe sideband interfrence from the Mexican station, Radio Educacion, Mexico City on 6185kHz.

BULGARIA: Radio Sofia, from March 28 when it moved to daylight time, now has English broadcasts one hour earlier: 0300 - 0430 on 7290, 9700 and 11,720kHz. There are five other English transmissions, including 1730 - 1900 on 6235, 9560, 9700 and 11,720kHz.

CHINA: Swiss Radio International from China is using two frequencies, 7480 and 11,690kHz with English at 1300 - 1330. On Saturdays the programme includes 'Grapevine' and 'The Two Bobs'. The best signal, direct from Switzerland, is 15,505kHz.

SPAIN: Radio Nacional de Espana has English to Africa at 1900 - 2000 on 15,375kHz, with some interference from KCBI. After 2000 the station has French until sign-off at 2100. The station's features include a full programme summary at 1955 and a request for reception reports to: Spanish National Radio, PO Box 156202, Madrid 28080, Spain. Another transmission which is heard in the South Pacific is the broadcast to North America at 0500 - 0600 and received on 9530kHz.

USA: WEWN, Birmingham, Alabama is best received at 0500 - 1000 on 7465kHz, and the broadcasts are hour-long Catholic services in German and Albanian, and at 0900 in Dutch. The station is a service of the Eternal Word Television Network, and gives the frequency and time each hour. It uses an interval signal — often for up to three minutes — before the hour, when the station ID is made. Reports should be sent to Bob German, Manager, Station WEWN, PO Box 380247, Birmingham, Alabama, USA. ❖

Shijingshan District, about 30 minutes drive from the current broadcasting building. The new 16-storied building will have a floor space of 41,800 square metres, enough to accommodate up to 50 language departments.

The building will be furnished with advanced recording and broadcasting equipment. Computers will link the entire process, from script writing to production, and broadcasting. Total investment for the project is more than US$40 million. Construction of the office and studio building is planned to be completed by the end of 1994, while it is expected that a further year will pass before the engineers have installed the recording and broadcasting equipment.

China Radio International broadcasts to Australia in English from 0900 - 1100 on 11,755, 15,440 and 17,710kHz. As well as broadcasting to an international audience on shortwave, China Radio International programmes are relayed to the Domestic audience within China in 13 cities on FM.

TWR closes Bonaire relay

The shortwave transmitters of Trans World Radio at Bonaire, in the Nederlands Antilles, are to close on July 1. Already the programmes of mediumwave PJB 800kW have been reduced, while the shortwave programme has been shortened by six hours per day.

On July 1, when the shortwave transmitters are taken out of service, a satellite link into Latin America will be in operation. In the past, the shortwave transmitters have been used to augment the coverage into Latin America. The present economic conditions are the reason why the high frequency transmitters are being closed.

At present, the Bonaire station consist of one 250kW and one 50kW transmitter, but it is expected that the former will be scrapped and the latter will be shipped to another Trans World Radio site.

One of the favourite programmes from Trans World Radio is its DX Programme, which will continue on shortwave until the end of June. It is heard Saturday at 1130 on 11,815 and 15,345kHz and on Sunday at 0330 on 9535 and 11,930kHz.

In another part of the world, Trans World Radio is increasing its shortwave coverage. This is the case in Sri Lanka, where a 12,500W transmitter, which it has purchased from the Sri Lanka Broadcasting Corporation, is now in operation using 6035kHz and operating at 1300 - 1530.

A new 100kW transmitter is also on order, which will be set up shortly. Meanwhile Trans World Radio has been operating for some months a 400kW mediumwave outlet on 882kHz.

More frequencies available

Another outcome of the recent Voice of America Conference was a statement from Richard Meecham of the BBC Monitoring Service, concerning the move to satellite coverage of some shortwave services — which will leave gaps on the shortwave bands. Many international stations are also trying to get into their target areas with mediumwave or FM transmissions. When they do so, this will mean a further lessening of shortwave usage. Some shortwave frequencies have already been freed up because of such AM or FM broadcasts.

The only move away from this trend is Radio Moscow, which maintains the same high frequency usage. In fact, Radio Moscow is using twice the number of frequencies that are used by the Voice of America. The loosening up of shortwave frequencies by international services means more channels are available, and shortwave listening is becoming more attractive.

The use of frequencies by gospel radio stations shows that there are 126 gospel broadcasters in operation, though the resources are by no means evenly spread. Less than 20% of them have overseas relay bases. However, some gospel broadcasters do not need such relays, as they only offer a regional service.

There are a lot of gospel broadcasters who fail to get a good signal into their target area. Many of these broadcasters just claim to target Europe, but the fault may be that they do not check their transmissions, or their frequency usage is such that they never make it.

KHBN verifies

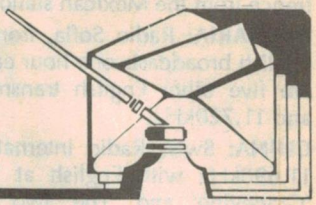
An interesting card from the central Pacific station, KHBN, located on Palau, has been received. A schedule and frequency change has been made, with the broadcasts now all on 9830kHz: 0800 - 1200 Chinese, 1200 - 1430 English, 1430 - 1530 Vietnamese, 2000 - 2330 Chinese, and 2330 - 0100 English. The transmitter is a 50kW RCA unit, according to the Chief Engineer. KHBN's full address is: Voice of Hope for the Pacific KHBN, PO Box 66, Koror, Palau 96940.

KHBN is part of the Voice of Hope network which has its key station KVOH in Los Angeles. This has been heard around 0400 on 9785kHz. In recent weeks it has been carrying a gospel programme with Dr Gene Scott, and this is simulcast with its Lebanon transmitter, Wings of Hope on 11,530kHz. There has been a call-in programme offering collect calls from anywhere in the world to the Los Angeles studios. The same programme is also carried on WWCR, Nashville on 5920kHz.❖

This item was contributed by Arthur Cushen, 212 Earn St. Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Eastern Daylight Time and 13 hours behind NZ Daylight Time.

Information centre

Conducted by Peter Phillips



Retraining, teletext, motor control and more

This time round we address the vexing questions of defining a computer technician, and what you have to do to become one. On more practical issues, how about a motorised billy cart — and there's more on interfacing a computer with a Teletext decoder.

Information Centre is that part of the magazine where we put things that don't really fit anywhere else. For this reason, this column covers a variety of topics, where the only common theme is electrical and electronics matters.

The first letter illustrates my point. It's not a technical question, yet it's one I'm sure many readers ponder, especially younger readers looking to electronics as a career path. No doubt there are varying perceptions of what an electronics technician does, what training is required, how intelligent a person needs to be to undertake training in electronics and so on.

Having spent the last 20 years involved in training electronics tradespeople, technicians and the like, I can say I've seen all types. Interestingly I've also seen the most unlikely people — even educational 'dropouts' — do extremely well in electronics.

But what area of electronics should you look to when thinking about a career? Most people nowadays probably think of computers, where 10 years ago they thought of TV servicing. Of course there are many other areas: industrial, communications, general servicing, design and so on. Quite often, people enter a particular field by chance rather than choice, and finally get to where they really wanted to be after many years.

The first letter this month is from a reader who wants to set himself up as a computer technician. I think quite a few readers will empathise with the writer and be interested in my reply. Here's the letter...

Servicing computers

I am aged 29, and following a trucking accident in 1987 I have had to retrain. I want to become an Electronics Technician specialising in computer maintenance and repair, and I am presently studying electronics through the Queensland Distance Education college. I attend Toowoomba TAFE College one night a week. I would like to study this full-time, but it seems there are no suitable courses in Queensland.

There is a suitable course at RMIT (Melbourne), but as I have a wife and three children, moving to Melbourne from a small country town is a big step. I have also looked at the Computer Maintenance Technology course offered by the Computer Power Training Institute, but it costs $8000 for a nine month course.

Can you advise me what I should do, when my end goal is to work for a computer maintenance business, or to set up my own business. (G.M., Warwick Qld).

These days, quite a few people who have sustained an injury look to electronics as a means of making a living. Generally, the lot of the technician is 'light duty' work, which suits anyone with a back injury or the like.

And where better to go than into computer servicing? After all, it's the growth industry of the decade and appears to offer more opportunities than other areas of electronics. To many people, the image of a computer technician is one of a white-coated, almost boffin-like individual who buzzes around air-conditioned offices with his box of hi-tech bits and pieces.

While I might be criticised for what I'm about to say, I think it's time to 'blow the myth'. Let's first of all define the term 'computer technician'...

Even five years ago, a computer technician was someone with a high level of training who serviced mainframe installations. Here the equipment is complex, expensive and very sophisticated. Backed up with considerable in-house training and either an Associate Diploma from a TAFE college or a Bachelor of Engineering from a University, the computer technician was indeed a skilled individual.

These people still exist, but now there is a new breed — those that service the personal computer market. As there are far more personal computers than mainframes, obviously the number of personal computer technicians is greater that mainframe experts.

So what is *their* training? In some cases, very little. In many cases a trade course in Electronics. Perhaps a few will have an Associate Diploma (or 'Engineering Certificate', as it used to be called). Some may have what is now called an Advanced Certificate in Electronics. But none (or very few) will have a course that specialises in computers. Rather, this knowledge will either be picked up though elective subjects in a TAFE training course, or more often through experience.

So how do these people manage to service a complex device like a computer? Simple! The same way *most* field servicing is done these days: replace the entire mother board, the hard drive, the floppy drive, the keyboard or whatever. If the monitor is faulty, send it to a TV repair firm.

That's not to say a computer technician of this type is simply a trained monkey. Such a person needs to be able to operate DOS, be familiar with the overall operation of the system and have a good basic knowledge of electronics. But that's about all. You don't need a degree or expensive training.

Instead you need initiative, an Electronics Trade course qualification (or its equivalent), and *experience*. Getting the latter may be the hard part, and quite a

few people learn about computers by offering their services on the basis that they know more than the customer. And they usually get away with it, as repairing a computer is often a matter of replacing whole assemblies. Only those with lots of time will try and faultfind at chip level.

So, G.M., if you want to work in the personal computer industry, you are probably already heading in the right direction. It's possible an Electronics Trade course is offered full-time somewhere in Queensland. If you want to be a mainframe expert, though, you might have to pack up the family and head for Melbourne.

But I stress again that *experience* is essential. All the training in the world can't replace hands-on experience. Perhaps you can find work (part-time maybe) with a firm dealing in computer sales and service. Good luck.

Teletext-PC interface

There seems to be quite a bit of interest in interfacing a Teletext decoder with a computer. In February I pointed out that a means of doing this would be appearing shortly (either in this edition or in May), following my comments in January that I thought such an interface should be possible.

Already the letters are turning up, even though at the time I'm writing this the February issue hasn't quite reached the streets. The first is from a reader with more than a passing interest in Teletext...

I read your article 'Enhancing DSE's Teletext Decoder' in the November issue with interest. Do you think the unit could be modified to send the teletext data to a computer? If so, you could take data from the transmission and enter it automatically into computer software, such as a spreadsheet for the stock prices.

More advanced applications are possible, such as those the society I represent presented to the Senate Select Committee on Subscription Television Services (Pay TV). This included using teletext-type services for a type of electronic newspaper. Several TV networks sell data broadcasting services using teletext technology, which so far has met with limited success. However, if low cost hardware could be made (by modifying the DSE kit), a free demonstration service is possible.

There is a global computer-based news service called 'UseNet News'. This is transmitted using academic computer networks and is available at all Australian Universities. The service is free and is available to anyone. However, it is difficult to receive if you are not on a University computer network.

UseNet News transmits about 40Mbytes of news per day. With some selectivity in the topic being transmitted, one teletext 'page' could be used to carry the service.

If you think the Teletext decoder modifications are feasible, I believe it's possible to interest TV stations and universities in the idea of carrying UseNet news. (T.W., Canberra ACT).

Because I'm not sure whether T.W. intended me to print his letter, I'm preserving his anonymity, and that of the society he represents. And as you know by now T.W., it is certainly possible to modify the DSE kit as will be revealed in the forthcoming article. Although I'm only now enjoying the benefits of interfacing a Teletext decoder to a computer, it seems others have been doing this for some time, as the next writer points out:

In the January issue, you published a letter from M.M. (Wembley Downs, WA) calling for a Teletext decoder that would store pages in memory. You mentioned in passing that you were thinking of interfacing such a device to a computer.

I am presently operating a commercially built device like this on an Amiga 500HD. Don't despair, the manufacturer also has versions for those less fortunate, such as IBM, Atari and Mac owners.

The device is about the size of a medium sized paper-back book, uses low-powered Philips I²C logic chips and outputs RGB signals for the teletext content as well as CVBS (video) and audio for the television programme.

The software provided with the unit lets you save data from Teletext in either ASCII format or teletext graphics, to download software when it is provided by advanced teletext providers (in the UK and Europe) and can auto tune.

There are a number of other facilities, including a memory of pages viewed, sequence programming — but not storage of all pages. For more information, contact Microtext, 7 Birdlip Close, Hordean, Hampshire P08-9PW, UK. (A.M., Kyeemagh NSW).

Thanks A.M., yours is the second commercial system I've heard of. What you don't mention is the cost. I understand (although I might be wrong in your case) that the cost of the hardware and support software is well over $1000. If this is so, it makes the DSE kit a very cheap alternative.

However, there may even be another way. Thought about designing and building your own Teletext decoder? It might be simpler than you think, according to an article we presented in our 'Solid State Update' section in December 1990. A reader (M.M.) faxed me an extract of the article which I'm including here.

GEC Plessey has announced what it claims is the world's first single-chip Teletext decoder. The MV1815 allows a complete teletext system to be built with just the addition of a single low cost DRAM IC. Up to 254 pages of text can be stored, depending on the size of memory, for immediate access by the viewer.

The MV1815 has an on-board data slicer circuit and dual page acquisition circuits. This ensures that the viewed page can always be kept live while the second acquisition circuit stores linked or other pages.

The device is controlled using a low cost I²C interface, allowing easy connection to a microprocessor. Multi- language capability is a feature with 14 languages supported. The device is manufactured on Plessey's 1.4uM CMOS process and operates from a 5V supply, drawing typically 20mA. For further information, contact GEC Components Sales Office, North Ryde 2113. Phone (02) 887 8222.

So there's certainly some activity on the teletext front. The coming article describing our interface also includes brief details of the I²C bus. This information should be useful if you want to design your own Teletext decoder or if you want to try interfacing a commercial decoder, such as those fitted to TV sets.

DC motor speed

Motor speed control is almost a technology in itself. These days, solid state controllers are used with small and large motors in applications ranging from a steelworks slab mill to model trains. But what about a billy cart?

I was recently given a 12V DC motor from a Sibbings motorised wheel chair. As I would like to use this motor in a billy cart, I rang Sibbings to find out about the availability of a speed control system. The cost is more than I want to spend on this project, so I asked the technical person from Sibbings what was required.

He was understandably unwilling to divulge the workings of the Sibbing's speed control, but said he thought Electronics Australia had published a suitable controller. I have so far been unable to track it down, if you have indeed done such a project.

He also pointed out that the controller should use transistors as the control elements, rather than a series resistor. He explained that a series resistor would waste power and get hot.

I would be grateful if you could help me either track down the article referred to by the Sibbings technician or point me in the right direction. (W.H., Box Hill Vic).

To the best of our knowledge, we haven't described a 12V DC motor speed

controller or anything that could be used in this application. This is a rather specialised area, especially when dealing with high current motors and often involves a complex switching circuit. In this arrangement, solid state switches (FETs, transistors or SCRs) are switched on and off to regulate the power to the motor. These are usually called chopper circuits, and their design depends on the type of motor.

To explain, all DC motors have two main parts: the armature and the field. The field develops a magnetic field in which the armature rotates, and can be produced by coils or (in smaller motors) by permanent magnets. There are four basic ways of connecting a field winding: separately from the armature, in series with it, in parallel (shunt) or compound (a combination of shunt and series). Therefore, there are five types of DC motors, as shown in Fig.1.

In all cases, the speed of the motor can be varied so it's either faster than the normal speed, or below it. The normal speed of a motor is its speed at rated armature voltage and rated field flux. If the armature voltage is varied while the field flux is held constant, the motor speed can be adjusted from zero to its normal (or base) speed. Keeping the armature voltage constant and weakening the field flux will increase the motor speed.

To reverse the direction of rotation of a DC motor, you have to reverse the current in either the field (to cause a reversal of the magnetic field) or reverse the current in the armature. This means that apart from the permanent magnet type, reversing the supply to the motor won't change the direction of rotation.

So how do you vary either the armature voltage or the field strength? In all cases this can be done with a variable resistor, or with a circuit that acts to control the *average* value of current in the circuit. A chopper is such a circuit, and its main advantage is that it consumes very little power.

Imagine a chopper as a switch that is opening and closing in rapid succession. Because power equals voltage times current, when the switch is closed (giving a zero voltage drop across the switch), no power is lost as current times zero equals zero. Also, when the switch is opened, the current will be zero, giving zero power loss again. Of course, a practical chopper circuit will dissipate *some* power, but a lot less than a series resistor.

So your contact at Sibbings is quite correct, and nowadays most motor control circuits use solid state switches. But perhaps we should be a bit more pragmatic here.

First, there is nothing wrong with using a series resistor to control the speed of a motor. Electric trains have been doing it for years. The problem is the heat developed in the resistor and the power lost as a result. When the power is from a battery, then obviously lost power means reduced running time.

But we are only dealing with a billy cart! Something for the kids to have a bit of fun with, not a vehicle to travel across

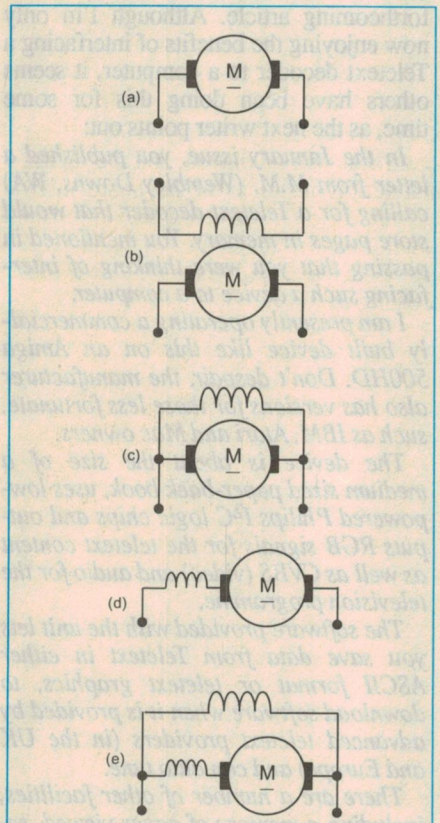


Fig.1

Australia. So, if it was me, I'd be looking at the simplest possible method. For instance, if you use a 12V car battery with exposed cell straps, you could make up a switch to vary the supply voltage in 2V increments, just by connecting to the various straps. Not ideal, but I bet it works.

Or, construct a high-power resistor or two and connect them via a switch in series with the motor. Ok, so they get hot and power is wasted — but it will still give the kids a good time!

The speed control of a wheelchair needs to be tightly controlled because of the vulnerability of its passenger, so a solid state speed control system is in order. But for a billy cart, such a system is overkill. So fit a resistor or two, and don't worry about having to charge the battery more than you might otherwise — the kids won't even know the difference!

VCR as a backup

Backing up a computer hard disk is something all computer owners either do; or wish they'd done. It's a boring task, that can take a long time if you have a large hard disk. Our next writer has an idea to change all that...

I have a PC with a hard disk, and I find backing up a considerable chore, even though little changes each day/week. Incremental backups help, but eventually everything needs copying, taking a long time. Ideally, a tape cartridge would be sensible, but it is hard to justify.

As with most PC owners I expect, I own a VCR and am convinced it should be possible to use it as a backup device. Provided it has the necessary capacity, it has the advantage of unattended/overnight backup instead of floppy swapping.

Based on 625 video lines times 25 frames per second, I calculate that at one bit per line, a 4-hour tape should hold about 20Mbytes of raw data. I've heard that VCR recording is not reliable enough to ensure the accuracy required of digital data, but at one bit per line, I expect there should be more than enough redundancy to cope.

The interface should be cheap, and I suggest a modified serial board with a different crystal to let it run at 15625 bps. This has the added advantage of ease of programming the backup utility. Replacing the usual 1.8432MHz crystal with either a 1.5 or 3MHz type should allow programs to communicate at the desired bit rate. Further circuitry would then be required to convert the digital data to/from a composite PAL signal. Frame sync could be instigated via the RS232 control pins, but I have heard that VCRs don't rely on vertical sync anyway.

I suspect that a higher storage rate is possible, maybe one byte per line or more, but my lack of electronic experience doesn't allow me to be confident of that. The PC must be able to keep up with the incoming data stream when restoring, of course.

I would be very interested in your views/comment on this (C.A., Walkerville SA)

While this sounds a good idea, I have a few reservations. First, assuming the method works, by your maths it will take 32 hours for me to back up my 160MB hard drive. OK, so we store one byte per line (8-bits). Now it's down to four hours, which is better, but still rather a long time.

Obviously your idea is to record the

computer data via the video record head, rather than the audio head. However, as you say, you would need good error correction routines as tape drop-out could cause considerable data loss.

I have a tape back-up for my system and the software to drive the tape is complex and includes a lot of error checking. For instance, it will let you back up selected files, a complete disk or only those files that have changed since the last back-up. Each copy can then be verified. Restoring from tape has the same facilities. This unit records eight tracks in parallel, and back-up usually requires several tape changes. Therefore, it can't be done unattended.

So, the main part of a system to allow a VCR to be the back-up device would probably be the software. The rest of the system is simply a means of transferring data to and from the computer-VCR. The electronics would probably be relatively simple, but there would be a lot of effort needed to perfect the software.

Still, it's a good idea in principle, although one that would need a lot of development. Any offers?

Digital Voice Recorder

I am writing to ask if the Digital Voice Recorder described in the October 1992 issue of EA could be used to record guitar riffs from a music source such as a CD. Only a few seconds of music would be needed, as it could be continually repeated on replay rather like a CD player where you can program the player to repeat a bit of music continuously.

The digital delay unit I use with my guitar also has this facility, but the problem is I can't slow the music without the pitch changing. Can the Voice Recorder be slowed without affecting the pitch? My MIDI recording system accomplishes this rather well. (V.S., Canberra).

Looking at the specifications of the IC used with the voice recorder, I doubt that it will achieve any more than your delay line. In both cases, the audio signal is converted to a digital form and stored. In replay the digital data is retrieved from storage then converted back to analog form. This is totally different to a MIDI system.

In both the voice recorder and your delay unit, the analog signal is fed to an analog to digital converter (ADC). This part samples the signal at regular intervals and produces a digital code to represent the voltage of the signal at the time of sampling. The waveform has to be sampled at least 10 times per cycle to get a reasonably accurate replica.

Therefore, the digital equivalent of an analog signal is a series of binary codes that represent the instantaneous voltage of each sample of the original signal. The frequency of the signal is the rate at which the amplitude changes between each sample.

For instance, if each sample produces the same binary value, then obviously the signal is DC. If the samples give a binary code that reaches a maximum and minimum every 10 milliseconds, the frequency is 50Hz.

Slowing the rate at which the samples are replayed must therefore affect the frequency (or pitch), in the same way as if the signal was in analog form.

MIDI uses a different arrangement altogether. Here a keyboard note is represented by a single bit. If that bit is a one, the note is on. Otherwise it's off. The keyboard (or MIDI box) determines the sound that will be played, and the digital data simply instructs the keyboard *when* to play a particular note. Player piano owners know all about this, as a piano roll can be played as slow as you like without affecting the pitch.

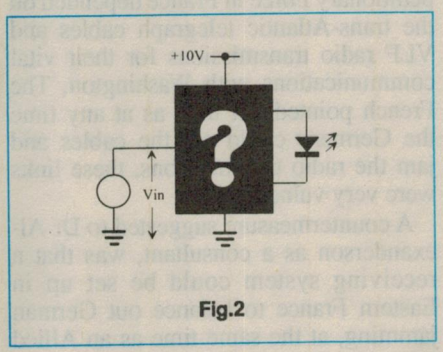


Fig.2

What??

Here's another question from the pen (or mind) of Wen Liang Soong, who has contributed before to our What?? section. He writes:

The circuit in the black box of Fig.2 consists only of resistors and diodes. It has five external connections as shown. The LED lights if the input voltage (Vin) is between 10V and 0V. If Vin exceeds 10V or becomes negative (less than 0V), the LED is off. What's in the box?

Answer to March What?

The answer is to connect the cells as a four by four matrix. That is, four parallel connected strings of four cells in series. The current in the circuit will be 3A, as the total resistance (including the internal resistance of the cells) will be 2 ohms with a voltage of 6V. This arrangement will also ensure the maximum power is transferred from the battery pack to the load, as they both have the same resistance. ❖

'SOLAR POWER' COMPETITION WINNERS

As promised, here is a listing of the winning entries in our recent Oatley Electronics/EA Solar Power Competition. There were a great many entries, many of which were of a high quality — making the job of our judges very difficult indeed. However after much deliberation, we finally selected the following winners:

FIRST PRIZE:

Winner of first prize was Mr Gavin Houston, of Henderson, NZ, for his design for a solar-powered tracking system for a solar hot water system. Mr Houston wins the Oatley Electronics 'second generation' IR night viewer, valued at $1800.

SECOND PRIZE:

Second prizewinner was Matthew Jimmieson, of Newmarket, Qld, for his design using a digital alarm watch to trigger a solar panel tracker. Mr Jimmieson wins the Oatley Electronics helmet-mounted binocular IR night viewer, valued at $649.

THIRD PRIZE:

Third prizewinner was Mr Stan Woithe, of Fulham Gardens, SA, for his design for a microprocessor-controlled solar panel tracker. Mr Woithe wins the Oatley Electronics second generation image intensifier tube, valued at $600.

FOURTH PRIZE:

Fourth prizewinner was Mr Robert Veres, of Springvale South, Vic, for his design for a compact colour identifier for people with colour-blindness. Mr Veres wins the Oatley Electronics 5mW laser gunsight, valued at $399.

FIFTH PRIZE:

Fifth prizewinner was Mr Glenn Sneddon, of Endeavour Hills, Vic, for his design of a solar energy monitor/logger. Mr Sneddon wins the Oatley Electronics 5mW laser diode pointer, valued at $199.

PRIZES 6-15:

The following entrants have each won a pack of 10 Oatley Electronics 6V/1W solar panels, to allow them to make a 10W solar panel valued at $85:

Mr Phil Radunz, of Kingaroy, Queensland.
Mr John Harding, of Morphett Vale in SA.
Mr Vic Duffy, of Rosanna in Victoria.
Mr Peter Borowski, of Glenroy in Victoria.
Mr Arron Darlington, of Port Augusta, SA.
Mr H.C. Harrison, of Brighton in Victoria.
Mr Andrew Gowan, of Dannevirke, NZ.
Mr Brian Dunn, of Old Noarlunga in SA.
Mr Simon Jansen, of Avondale, NZ.
Mr Mario Annetta, of Reservoir, Victoria.

PRIZES 16-25:

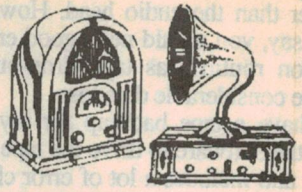
The following entrants have each won a complete kit of parts for the Oatley Electronics Electronic Key project, as described in the July 1992 issue of *EA*. Each kit includes two keys and one receiver, and is valued at $59:

Mr B.G. Wriede, of Bald Hills, Qld.
Mr Brian Taylor, of Harvey, WA.
Mr Matthew Bordignon, of Glen Iris, Vic.
Mr Colin Stewart, of Broken Hill, NSW.
Mr Brad Davies, of Cessnock, NSW.
Mr Graham Allison, of Mairangi Bay, NZ.
Mr J.W. de Vos, of Prospect, NSW.
Mr Duncan Wilkie, of Sandy Bay, Tas.
Mr Ernst Gegenhuber, of View Bank, Vic.
Mr Chay Bun Te, of Fitzroy, Vic.

Our congratulations to these winners, who should be receiving their prizes very shortly, and our thanks to all of the readers who entered the competition — even those whose entries were not successful in winning a prize. Our thanks also to Oatley Electronics, for donating these prizes.

Vintage Radio

by PETER LANKSHEAR



The vintage Beverage

No, *EA* is not joining the glossy magazine fashion in featuring a wine column — this month we are presenting the story of a legendary aerial. Now about 75 years old, the Beverage or 'Wave' antenna is generally regarded as the ultimate for low and medium frequency reception.

Much of modern electronics would be practically unrecognisable to the early radio pioneers, but some early technology, especially that of aerials has survived. One of these, the Beverage, is still unsurpassed for its directional qualities combined with weak signal reception in the crowded broadcast band.

Dr Harold H. Beverage was the leader of the team who worked on a directional receiving aerial project, officially known as the 'Wave Antenna', early this century. Some of the background information that follows has come from a letter written in 1981, in which he relates the story behind the evolution of the aerial that later took his name.

In 1917, as America entered World War 1, the Chief Radio Engineer of General Electric was Swedish born Dr E.F.W. Alexanderson, best known for his development of the Alexanderson RF alternator — until the early 1920's the most efficient and powerful generator of what was then called 'RF'.

The final version of Alexanderson's alternator was capable of producing 200 kilowatts directly into an aerial, at frequencies of up to 33kHz. Twenty of the 50-ton 200kW monsters were built, and some were not retired until after World War II! In fact, one at Varburg in Sweden is still operational, and is run up for a test period each month.

In those far-off days, 2MHz was the upper limit for existing technology and what is now the broadcast band was actually called short wave. America's Expeditionary Force in France depended on the trans-Atlantic telegraph cables and VLF radio transmissions for their vital communications with Washington. The French pointed out that, as at any time the Germans could cut the cables and jam the radio transmissions, these links were very vulnerable.

A countermeasure suggested to Dr Alexanderson as a consultant, was that a receiving system could be set up in Eastern France to balance out German jamming, at the same time as an Allied jamming 'barrage' set up in Western France would prevent any German eavesdropping of the American transmissions. The problem was to develop a directional receiving aerial with two 'nulls': one to eliminate the German jamming, the other the Allies' own barrage signals.

The resourceful Dr Alexanderson had about five possible solutions, but the one chosen for development was similar to a 'Ground Aerial' developed in Europe by F. Kieblitz.

Several early workers, including Marconi, had discovered that a wire near the ground exhibited directional receiving effects. In 1911, Kieblitz (who was investigating currents induced in the earth by passing radio signals) found that he could obtain good directional signals at the centre of a length of wire supported about one metre above the ground and earthed at its extremities.

Beverage's tests

Preliminary experiments were conducted by Dr Beverage, one of Alexanderson's staff, at New Brunswick (New Jersey) near the high powered Alexanderson alternator equipped US Navy station NFF. Two rubber insulated wires, each two miles in length, were laid in line on the ground in a Southwest - Northeast direction.

The test equipment was connected in the middle, at the junction of the wires, by adjustable phasing networks. Although the Southwest wire terminated only two miles from the NFF transmit-

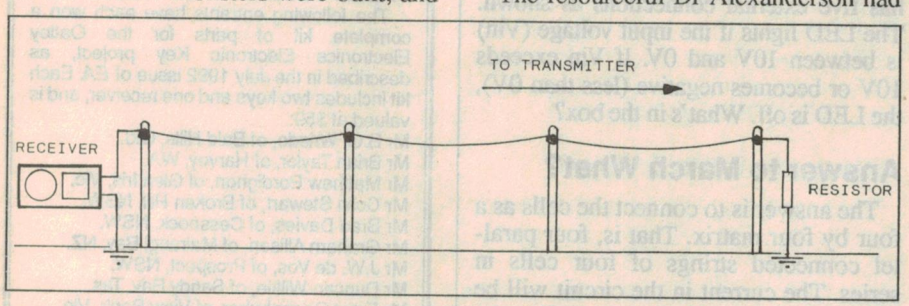


Fig.1 (above): The classic Wave or Beverage broadcast aerial, with a length of wire between 300 metres and one kilometre for MF reception, and supported about three metres above the ground.

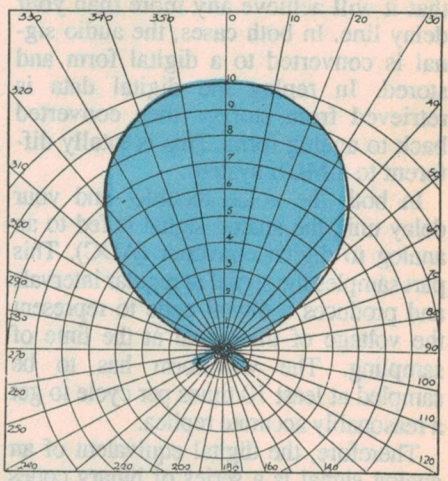


Fig.2 (right): The polar diagram of a one-wavelength long Beverage aerial, showing the gain and directivity performance usually associated with VHF arrays. A little surprising, considering the aerial's simple contruction...

ting aerial, by balancing out NFF signals with the phasing network, and despite there being only a small frequency difference, reception of the MUU transmissions from Carnarvon in Wales was possible.

The success of what was at this stage called the Barrage aerial was noted by the US Navy, who requested that a similar system should be installed by Dr Beverage at its receiving station at Bar Harbour, on the coast of Maine in the far Northeast of the US. Again two-mile lengths of wire running Northeast and Southwest were strung out. Although here the terrain is quite mountainous, results were again excellent.

As expected, the Northeast pointing wire received strong European signals, but the Southwest wire produced little but heavy static. At first Dr Beverage attributed this apparent anomaly to a 'dog-leg' in the aerial, where it deviated to cross a river by way of a bridge; but when he straightened up the wire there was no difference.

Intrigued by this odd behaviour, he took a receiver to the Southwest end of the Southwest wire — to find that there was no static, but the European signals were now just as strong as with the other wire! Obviously the aerials were highly directional and the static, which was coming from thunderstorms in the US Southwest, was only a problem when the wire pointed towards the source.

Beverage next shifted his experiments to sandy country at Riverhead on Long Island, where he ran out a six-mile length of wire alongside a road. Cutting the receiver in at various points along the wire enabled him to make observations to gain a better idea of what was happening.

He determined that the wavefront of a signal built up an increasing voltage as it travelled along the line of the aerial wire. Signals or static from the reverse direction were not reflected back, but were absorbed in losses in the wire which, due to its proximity to the ground, were high.

By a fortunate coincidence, at the frequencies used, the two-mile length decided on turned out to be optimum for wire in contact with the ground.

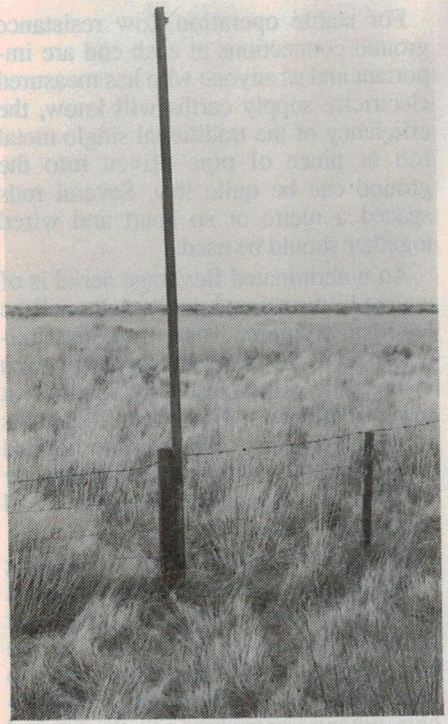


Fig.3: The Southland Branch of the New Zealand DX League has a listening post with a selection of Beverage aerials providing world-wide reception of MF transmissions. Situated on a tussock and scrub covered shingle spit with sea water on practically three sides, and with the nearest power line a couple of kilometres distant, conditions are ideal for this type of aerial. This is a typical aerial pole for the Southland array.

Rice & Kellogg again

At this stage measurements were required to confirm the experimental conclusions. For this work the team was joined by Chester Rice and Edward Kellogg, who were later to make the first practical moving coil loudspeaker (see *EA*, May 1990). A nine-mile aerial was built, using regular telephone line construction. With the height now several metres above ground, losses were reduced and the velocity of signals in the wire increased.

With the end nearest to the transmitter terminated with a suitable resistor, signals from the reverse direction were completely absorbed without the need of phasing networks.

Officially called the 'Wave Antenna' from its being about a wavelength long, the new aerial worked well over a wide frequency range. The results and conclusions from these experiments were published in an extensive report in the *Transactions* of the American Institute of Electrical Engineers for 1923.

Later renamed

After World War I, there was a concentrated effort to receive American amateur transmissions in Britain. As initial tests were unsuccessful, leading US amateur

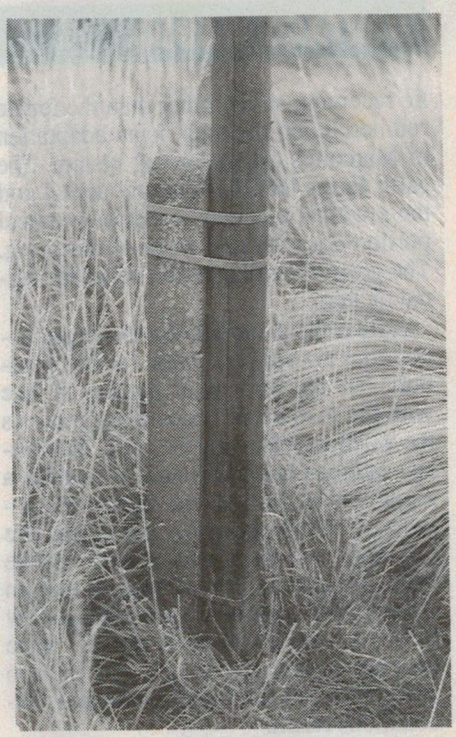


Fig.4: Fence posts can provide secure mountings for lightweight poles, as this close-up shows.

Paul Godley was sent to Scotland in 1920 with an Armstrong superheterodyne receiver. He happened to be travelling on the *Acquitania*, at the same time as Harold Beverage who, when he discovered Godley's mission, promptly designed a suitable Wave antenna for the project. The results were most successful, with many US signals received, and in his report in *QST* magazine, Godley referred to the aerial as the 'Beverage'. The name has stuck ever since.

So much for the background. How does the Beverage aerial work, and what are the constructional requirements?

The bad news

First though, it is not normally possible to construct a Beverage aerial in an urban area. The absolute minimum size is about half a wavelength at the lowest frequency to be received. To cover the broadcast band, the shortest length is about 300 metres, with a kilometre not too long. Furthermore the wire must run reasonably close to the direction of the incoming signals. However, if space is available, as Fig.2 shows, the directivity and signal pickup are superb, making it the ideal broadcast band aerial for DX and for country listeners remote from transmitters.

Regardless of whether it is a wire suspended from a pole, a bed spring, or just a lead dangling from the rear of the chassis, the usual medium frequency domes-

tic receiving aerial, other than the ferrite rod aerial and the loop, is an adaptation of Marconi's original aerial system. The earth forms half the Marconi aerial, and the practical outcome is that the vertical portion does the real work of receiving. The greater the height, the better the signal pickup.

Unlike the Marconi, the Beverage aerial does not rely on height for its operation, but the horizontal portion in line with the path of the incoming signal. As the wave travels along the wire, the voltage induced builds up until it reaches a maximum at the receiver end of the aerial wire. So far so good, but in real life this does not work with a wire remote from the ground. The reason is that an electric current does not travel as quickly in a wire as an electromagnetic wave moving at the speed of light in free space. The two get out of phase and cancellations result.

The trick with the Beverage aerial is to have the signal 'drag its feet', as it were. This happens close to poor-to-medium conductivity soil, where the wavefront becomes tilted. With the wire at the correct height the retarded signal and the induced voltage remain in step, with the result that the further the wave travels along the wire, the greater is the voltage build up in the aerial.

Conveniently, with typical soil conductivities, a suitable height for the broadcast band happens to be two or three metres. One perhaps unexpected condition could arise where very high conductivity soils may not create sufficient retardation.

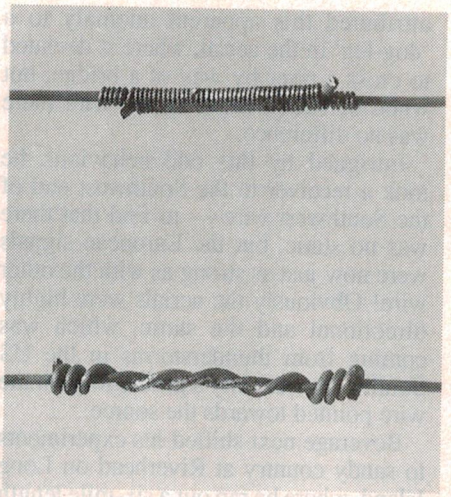


Fig.5: Two splices suitable for aerial wires. To avoid corrosion, the binder wire in the upper example should be of the same metal as the line wire. Solder only the centre of splices, or metal fatigue may eventually cause them to fracture.

Signals arriving at the side of a Beverage antenna encounter a different situation. The voltages that are induced are random in phase, and are not additive. Side on, it behaves more like a Marconi aerial of very small height, and consequentially there is relatively little conventional aerial action.

Making one...

For readers with plenty of real estate available who would like improved broadcast reception, a 'homebrewed' Beverage could be well worthwhile. The ideal is to use standard telephone line construction, and it may be a practical proposition to purchase some surplus Telecom equipment.

Depending on height and strength, poles can be spaced at intervals of 50 to 75 metres. Copper wire has the best conductivity, but galvanised iron wire is quite satisfactory and is stronger than copper. Any wire splices should preferably be soldered, and two suitable methods are shown in Fig.5. Oxidised contacts from unsoldered splices can create diodes, which may generate intermodulation and other interference.

If Telecom type material is not available, sapling poles can be used, or lengths of 50mm-square timber can be strapped or bolted to fence posts. The chief requirement is to have adequate headroom and security against weather and stock. Heavier poles can be fitted with telephone type insulators, but for small diameter supports, electric fence insulators are suitable.

Must be terminated

For stable operation, low resistance ground connections at each end are important and as anyone who has measured electricity supply earths will know, the efficiency of the traditional single metal rod or piece of pipe driven into the ground can be quite low. Several rods spaced a metre or so apart and wired together should be used.

An unterminated Beverage aerial is of course bi-directional, and results will be less than optimum. There is no discrimination from the rear, and standing waves in the wire may cause cancellations at some frequencies. This effect, of signals varying cyclically, can often be noticed on a car radio when travelling directly towards or away from a transmitter and parallel to a pole line.

The nominal value for the terminating resistor is around 500 ohms, and can best be found by test — although it may not be consistent over the whole of the broadcast band. About the best way to determine the value is connect a 1000-ohm potentiometer between the far end of the aerial and the earth connection.

To adjust the potentiometer may require some ingenuity. A visual link, temporary telephone line, cordless phone or CB radio link or similar, and an assistant are necessary. With a distant signal from the *rear* of the aerial tuned in on the receiver, the potentiometer is adjusted for minimum output. Its resistance is then measured and a fixed resistor of the same value is connected permanently.

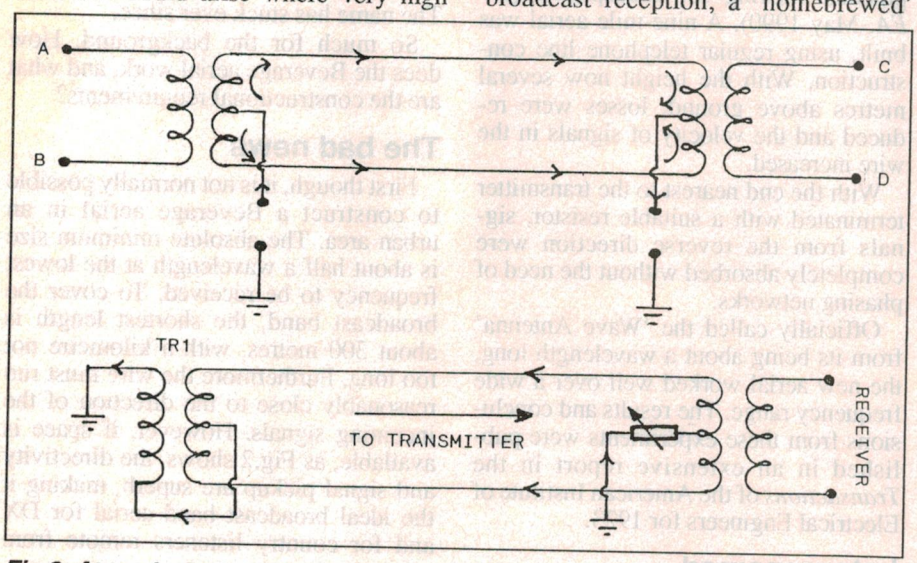


Fig.6: At top is the basic idea of a 'phantom' circuit, with a two-wire line carrying two independent circuits — one from AB to CD via the repeating transformers, using only the two lines, and the other using both lines in parallel with the earth as return path. Below is shown how the idea is used to 'reverse' a Beverage aerial, allowing the terminating resistor to be located at the receiver end.

Coating the resistor with a layer of epoxy resin is sufficient weatherproofing.

Phantoms & ghosts

There may be situations where an aerial can only be built in the 'reverse' direction, and furthermore, adjusting the termination would obviously be easier if the resistor could be alongside the receiver, rather than at the far end.

A Beverage aerial built with two parallel wires can be reversed by means of the *phantom* circuit — a trick nearly as old as telephony. The wires operate as the aerial in one direction and as balanced feeders in the reverse.

As can be seen from Fig.6a, by using 'repeating' transformers with centre-tapped windings, it is possible to derive a second circuit from a single pair of wires. In the days of open-wire lines, balanced phantom circuits were common, as they enabled considerable savings in wire. For the cost of four repeating transformers, two physical pairs produced a third circuit.

It was further possible to derive a 'ghost' from two phantoms, creating seven balanced pairs from eight wires. Two ghosts could even produce a 'spook', or 15 circuits from 16 wires, but the exercise was by this stage getting a bit out of hand!

By using two conductors, the phantom principle can be adapted to the Beverage aerial. Construction should be reasonably symmetrical, with a wire spacing of about 50cm.

As can be seen from Fig.6b, the two wires work in parallel as an aerial, and the signal builds up in the normal manner as it travels away from the terminating resistor. At the far end, the signal is coupled by means of the repeating transformer back into the two wires — which now operate as a balanced feeder line. A similar transformer at the receiver end connects the line to the receiver and provides the connection for the terminating resistor — which can usefully be adjustable, to allow easy nulling.

During a thunderstorm, an aerial as big as the Beverage can pick up a lot of energy, even without a direct strike. When it is not in use, never leave a receiver connected. For good measure, it is also wise to ground the aerial.

Underground aerials?

Older textbooks commonly refer to underground aerials, and illustrate a wire inside a line of pipes. There is often mention of static reducing properties, implying that the ground acts as some sort of a filter. However, as these descriptions are short on specifics, it is likely that the information is not first hand.

It seems possible that the original idea of an underground aerial was derived from a Beverage aerial, buried just beneath the surface of very low conductivity soil. Presumably any static reducing properties were from the directional effects discovered by Harry Beverage. If this is the case, conventional Beverage aerial construction as described earlier in this article should be as effective as any underground installation, and a lot less expensive! ❖

Collector's Corner

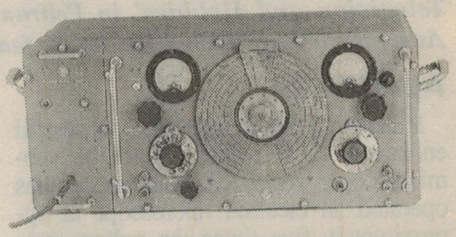
Where readers display prized items of radios and other equipment from their collections, and/or seek information from other collectors...

Thanks, and a request closer to home...

In this column in the January issue, we published a request from 'A.P.' of Cronulla, NSW for the circuit of a Triplett RF signal generator he wanted to restore. We were delighted to see that two different readers responded, sending in copies of not only the circuit schematic but also the complete user manual! Needless to say we sent them off to 'A.P.', who is most grateful and has asked us to convey this to the readers concerned.

There's no doubt that EA's readers collectively possess an enormous fund of technical information, and are most generous in sharing it. This being the case, and also because we're a little short of Collector's Corner items at present, I'm prompted to make a request myself — for the circuit of another old RF signal generator (I too am a collector of old test gear!).

This one is a classic AWA model, pictured at right. It's a type 3R7231, and I think it was made in the 1940's. I remember using one very much like it when I worked there, in the late 1950's. It's built in a big and very solid aluminium case, with a solid brass disc dial on which the tuning scales are all engraved. There are 10 bands, tuning from 95kHz to 31MHz. The two meters read modulation



(AM only) and RF output respectively. The power supply is in the separate compartment on the left-hand end.

It appears to have a 6V6 as the main RF oscillator, and another as a modulator; but there are other valves as well. It's beautifully made, and when I get time I want to bring it back to full working order. Is it possible that one of our readers can provide me with a copy of the circuit, or might even be able and prepared to loan me the manual to make a photocopy? **(Jim Rowe, *EA* editor)**

More contributions, too!

While I'm making requests, we do seem to be experiencing a drought at present regarding Collector's Corner contributions. What's happened to all of you keen collectors — isn't there anything you want to boast about, or need help with?

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

April 1943

Electron microscope: In a successful endeavour to see deeper into the sub-microscopic world, RAC laboratories has operated an electron microscope at approximately five times the voltage previously employed. The higher voltage permits the exploration of materials and organisms two or three times thicker than previously.

The use of 300kV potentials does not increase the resolution of what is seen through the electron microscope, but it does make it possible to see internal details of some specimens to better advantage.

Microphotographic record: In order to preserve centuries-old manuscripts and historic documents against war damage, a London photographer is snapping 10 documents a minute. His electric camera, working in the glare of four powerful lights, holds 1500 feet of film.

Each exposure picks up perfectly the slightest mark on the original document, and the print can be enlarged to a considerable size. This 'microscopic record' of history will eventually be sent to America for safe keeping by the Congress Library.

April 1968

Flying clock: Hewlett-Packard has again conducted a series of 'flying clock' experiments with its caesium-beam time standards, for the first time visiting Australia.

The experiments extended over 41 days and the clocks jointly covered some 100,000km. Two clocks and three teams participated. By comparing the clocks with the 'house standard' before and after the trip, the time differences for the travelling clocks were 1.7 and 3.5us. The time correlations on the trip were made to a net accuracy of about 0.1us.

The differences are explained in terms of a gravitational time shift, since the flying clock is further from the earth, and a time dilation produced by the relative velocity between the clocks.

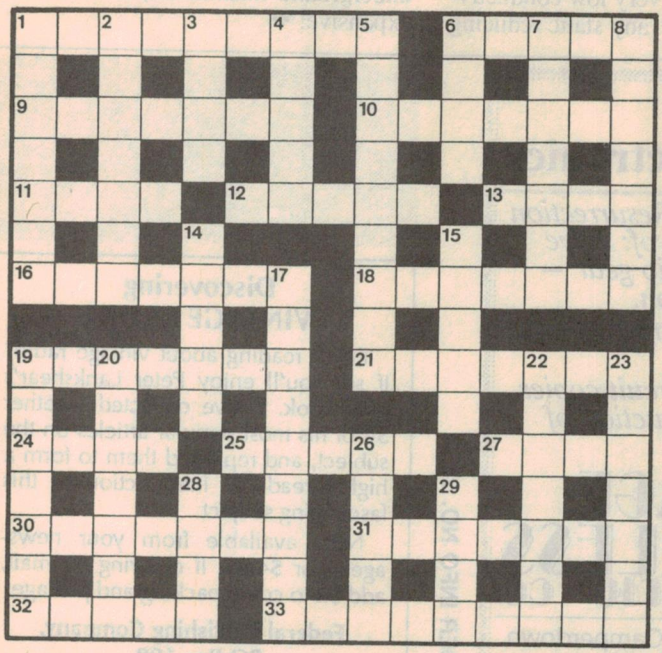
Crystal controlled watch: The Swiss watch industry has announced the prototype of a wristwatch timed by an electronic quartz crystal control. This is believed to be the first time that this technique has been applied successfully to a wristwatch.

The breakthrough involved scaling down the crystal and using special ICs with low power consumption. The watch is claimed to vary less than 30s in a year.

Private communications system: A $1m contract to build Australia's largest private telecommunications system has been awarded to STC for the 260 mile iron ore railway link between Mt Newman and Port Headland, in the north-west of Western Australia.

The system, which is fully transistorised, will put the mine and port in instant communication, and enable them to talk to the train drivers over every part of the line. It will also keep them in touch with maintenance camps and vehicles. ❖

EA CROSSWORD



ACROSS

1. Instrument of communication. (9)
6. Insulator in certain capacitors. (5)
9. Again made a transcription. (7)
10. Serviceman's jobs. (7)
11. Sweep through range of frequencies. (4)
12. Abbreviated term for a rev counter. (5)
13. Acronym for the National Asscciation of Testing Authorities. (4)
16 & 18. Important job in computer industry. (7,7)
19. Element 65, a metal. (7)
21. Transaction at an ATM. (7)
24. Dissipation of power. (4)
25. Gradient of a graph. (5)
27. Form of lightning. (4)
30. Well-known electronics brand. (7)
31. Part of 1 across. (7)
32. Return a counter to zero. (5)
33. The taking and transmission of measurements. (9)

DOWN

1. Forces, as does a rocket motor. (7)
2. Kind of filter. (3-4)
3. Unit of sound measurement. (4)
4. Letter commonly used as an electrical symbol. (5)
5. Direction of our gravitational field. (9)
6. Non-electronic instrument, the —— organ. (4)
7. A coil of a transformer. (7)
8. Again initiate an operation. (7)
14. Radio and TV are the electronic ——. (5)
15. Sources of light. (5)
17. Double transmission of entertainment. (9)
19. Communication satellite launched in 1962. (7)
20. Opposes flow of electrons. (7)
22. Illuminated by the night sky. (7)
23. Supposed force in telepathy. (7)
26. Piano control. (5)
28. Aerodynamic force. (4)
29. Weather condition with zero anemometer reading. (4)

SOLUTION FOR MARCH 1993

R	A	D	I	O	A	C	T	I	V	E		R	F	I
E		A		T			N		M		E			N
A	M	M	E	T	E	R		D	R	I	F	T	E	D
R		P		O		I		I		T		R		U
M	A	I	N		I	N	P	U	T		M	A	S	S
S		N		P		G		M		R		I		T
	I	G	N	I	T	E	R		W	I	N	N	E	R
O			X		R		G		N					Y
H	U	G	H	E	S		G	A	D	G	E	T	S	
M		O		L		A		U		S		R		S
M	E	A	N		A	L	I	G	N		T	E	M	P
E		H		S		F		E		F		E		E
T	W	E	E	T	E	R		S	T	A	R	T	E	R
E		A		A	E				I		O		R	
R	A	D		R	A	D	I	O	G	R	A	P	H	Y

EA with ETI marketplace

ADVERTISING RATES FOR THIS PAGE

SMALL ADS: The minimum acceptable size of 2 centimetres x one column costs only $50. Other sizes up to a maximum of 10 centimetres are rated at $30 a centimetre. **CLASSIFIEDS:** $4 for 40 letters. Just count the letters divide by 40 and multiply by $4, ROUND UP TO THE NEAREST WHOLE NUMBER. **CLOSING DATE:** Ads may be accepted up to the tenth of the month two months prior to issue date. **PAYMENT:** Cheque or money order only. Please enclose payment with your advertisement. Address your letter to: **THE ADVERTISING PRODUCTION MANAGER, ELECTRONICS AUSTRALIA, P.O. BOX 199, ALEXANDRIA NSW 2015**

FOR SALE

KIT REPAIRS: Fixed price servicing on all kits, no job too small, fast turnaround, construction service also available. Ph: (02) 649 2134.

VIDEO HEADS "HQ" JAPANESE HIGH QUALITY – HIGH OUTPUT:

Up to 64%	Less than some Japanese Heads	
Up to 41%	Less than some Non Japanese	
AKAI	BV-1030A220D	$29
AKAI	BV-V1017A170A	$29
GOLDSTAR	413-050	$29
AWA	928B09004	$36
HITACHI	5458104	$33
SONY	DSR-36R	$41
NEC	82423AH1	$33
NEC	82434AH1	$55
FUNAI	8000-01-13	$29
TEAC	8059-01-19	$29

This is a sample of our Tax Inclusive Prices Need an Unusual/Expensive Head ie. AWA3000? We Will Get It!! Ph/Fax Now for Price List Allthings Sales and Services (09) 349 9413.

AMIDON FERROMAGNETIC CORES: For all RF applications. Send business size SASE for data/price to RJ&US Imports, Box 431 Kiama NSW 2533. Agencies at Geoff Wood Electronics, Sydney: Webb Electronics, Albury: Assoc. TV Service, Hobart: Truscott Electronics, Melbourne.

LOUDSPEAKER REPAIRS, ALL BRANDS: Don't discard old favourites. Foam surrounds replaced at a fraction of new driver cost. Price list available. AMP-K Electronics P.O. Box 327 N.Ryde 2113. Ph. or Fax (02) 878 2291.

WEATHER FAX PROGRAMS: For IBM XT/AT's *** "RADFAX2" $35, is a high resolution, shortwave weather fax, morse & RTTY receiving program. Suitable for CGA, EGA, VGA & Hercules cards (state which). Needs SSBhf radio & RADFAX decoder. *** "SATFAX" $45, is a NOAA, Meteor & GMS weather satellite picture receiving program. Needs EGA or VGA, & "WEATHER FAX" PC card. *** "MAXISAT" $75 is similar to SATFAX but needs 2mb of expanded memory (EMS 3.6 or 4.0) & 1024 x 768 SVGA card. All programs are on 5.25" or 3.5" disks (state which) + documentation, add $3 postage. ONLY from M. Delahunty, 42 Villiers St, New Farm 4005, Qld. Ph (07) 358 2785.

PLANS FOR 1KW LOW-REVVING BRUSHLESS GENERATOR: - "The Homebuilt Dynamo" details, call Al Forbes, 0011-649-818-8967

UNUSUAL BOOKS: Electronic Devices, Fireworks, Locksmithing, Radar Invisibility, Surveillance, Self-Protection, Unusual Chemistry and More. For a complete catalogue, send 95 cents in stamps to: VECTOR PRESS, Dept E, PO Box 434 Brighton SA 5048.

INTELSAT: International satellite (telivision) receiving system (movies, sport, news) commercial 4.8mts solid dish, plus system electronics package can see operating $3995.00 ono. Phone Rod (08) 387 0372.

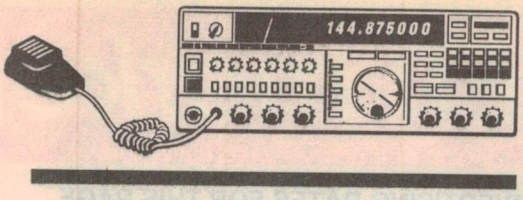
SELL VERY OLD RADIOS AND TUBES: comm. rec. books, manuals etc. Will pack and despatch. (07) 356 6052.

A 4MB SIMM: can now be used in my printer Buffer kit, and my PC Printer Port driven Z80 Micro Development board has a Basic Interpreter. Short Form Kit prices include Postage. Buffer $52, Z80 Dev. $76, or send $2 for my 3.5" promo disk. Don Mckenzie 29 Ellesmere Cres Tullamarine 3043.

KITS ASSEMBLED OR REPAIRED: Low rates. Contact Autronics on (08) 294 8591.

SILICON RECTIFIERS: 250A 200V with heat sink 25 dollars, 125-80-60-40-30-20 with or without heat sinks. SCR 50A with heat sink $18. 60A W.heat sink $22. 3 only 300A SCR with heat sink $60. Rotary transformers 2-2.25-3.5-4-9-10A. Ring 51-61-54-0 Tom Borbas, 40 Union St. Erskinewill Sydney.

Amateur Radio News



No disk version of Call Book

Bill Roper has clarified why the WIA is unable to supply the information in the *1993 Call Book* on floppy disk, or indeed any form of electronic media. The reason for this is that it's apparently prohibited by the contract between the WIA and the Australian Government Publishing Service.

The WIA only has a licence, it seems, to publish the *Call Book* in its printed book format. Along with the copyright provisions this excludes other means of publishing the information — including in electronic form, such as supplying the information as a text file on computer disk.

This is all rather frustrating, as many people including radio amateurs are now using personal computers, and an electronic version of the *Call Book* would surely be very convenient for rapid reference and personal updating. The WIA in fact receives quite a few requests for this.

It wouldn't matter too much, perhaps, if the AGPS made available a magnetic/electronic version of the information from another source, for a nominal fee. However no such alternative source appears to exist, effectively preventing Australia's amateurs from moving into the 'information age'.

It's hard to see why the DoTC/AGPS has taken this stand, which seems designed purely to restrict access to what is essentially public information. Allowing the WIA to publish the information in magnetic and/or electronic form would be both logical and in the public interest, one would think.

New weather fax from Antarctica

The WIA's Federal Office reports that a new station transmitting weather charts by facsimile (fax) on HF from Antarctica has joined the well-known Bureau of Meteorology HF weather fax stations AXM (Melbourne) and AXI (Darwin).

Located at Casey Base on the Antarctic continent, the new station signs VLM and runs 1kW FSK. It was announced by the Bureau of Meteorology, Tasmanian and Antarctic Region late in December.

Meteorological charts from the Bureau's three stations can now be received from 25° North to around 80° South, on an 'all-day, all year round service', the Bureau apparently claims. A schedule booklet setting out times, frequencies, data and chart reading information for AXM, AXI and VLM is available from the Bureau's Melbourne office. Write for an application form, to:

Angus Low, Bureau of Meteorology, c/- PO Box 1289K, Melbourne Vic 3001.

AR magazine's 20-year index

The latest WIA newsletter also reminds those amateurs who are members that an index of articles published in *Amateur Radio* magazine, reaching back to 1968, is available both on disk and in hard copy form from the Federal Office.

Disks can be obtained in ASCII format for $10.00 each (including postage), on either 3.5" or 5.25" floppies. Hard copy costs $10.00, again including postage.

However, the alternative database file format (.DBF) is more useful if you have suitable software, as it makes searching and viewing easier. In .DBF format the index can be obtained on 3.5" disks for $10.00 each, while on 5.25" disks it costs $12.00 each (both including postage).

For those with a computer who do not have software facilities to read and search .DBF files, the index can now also be obtained with software that allows viewing, searching and updating. All you have to do is request it.

The software for viewing and searching the .DBF format index was written and provided free of charge by Nigel Dudley, VK6KHD.

Novice Study Guide

Several years back the WIA published a Study Guide for the NAOCP, which took the DoTC syllabus for the Novice examination and expanded it to define the depth of examination for each topic.

Stocks of this booklet are still available and the WIA's general manager and secretary, Bill Roper VK3ARZ recommends that both students and lecturers use it to ensure that all the necessary topic areas have been studied.

The *Study Guide for NAOCP* is also available from the WIA's Divisional Bookshops, and costs only $1.50.

Warning on 10GHz safety

A recent Sunday morning broadcast by the NSW Division of the WIA carried a warning from Mark VK2XOF of the Gladesville ARC, and Lyle VK2ALU of the WIA Federal Technical Advisory Committee, regarding the safety aspects of equipment operating at 10GHz.

Apparently some amateurs have recently obtained microwave telurometers, with a view to conducting experiments on the 10GHz band. VK2XOF and VK2ALU warn that there's a safety hazard with any equipment operating at these frequencies, especially when operating in enclosed areas, and where children may gain access.

Those using this equipment are advised to avoid looking into the open end of any waveguide carrying microwave energy, and to ensure that curious children do likewise — serious eye damage can occur.

New ARRL packet radio companion

The American Radio Relay League has published a new book in its 'ARRL Companion' series, in this case written specifically for amateurs who are exploring packet radio operation for the first time. *Your Pocket Companion* is designed to 'cut through' the confusing jargon of packet radio terminology, providing clear and easy-to-understand explanations.

The author is Steve Ford WB8IMY, and he gives clear information on setting up a basic packet station, how to access bulletin boards and use the other facilities of packet networks. Specialised networks such as 'DX PacketClusters' are also discussed, along with ROSE, TCP/IP and TexNET. The reader is also shown how to use the many amateur radio packet satellites now in orbit.

Copies of the new book should be available from larger technical bookstores, but it's also available direct from ARRL Publication Sales, 225 Main Street, Newington, CT 06111, USA. The quoted price is US$8.00 plus US$3.00 for mail delivery or US$4.00 for delivery via UPS.

Austel comms technology report

Telecommunication regulator AUSTEL is apparently to report to the Federal Government by the middle of this year on emerging technologies in Australia aimed at providing 'personal communication services' (PCS).

These new services use a broad range of 'wireless-based' (i.e., radio) communication services, together with computer networking technology to provide a sophisticated mobile-portable network.

Both voice and digital data communication technologies are involved. The WIA has an active monitoring watch on these developments, in order to assess their possible impact on the amateur service. ❖

Electronics Australia's

Professional Electronics

S·U·P·P·L·E·M·E·N·T

NASA TRANSMITS DATA OVER 2.2M-KILOMETRE OPTICAL PATH!

SIEMENS PRODUCES SILICON BIPOLARS WITH A CUTOFF HIGHER THAN 44GHZ

MORE TIPS ON VALVE AMPLIFIER DESIGN

PANASONIC'S NEW ULTRA-THIN NOTEBOOK PC USES 3.3V CIRCUITRY TO ACHIEVE UP TO 11 HOURS OF OPERATION

NEWS HIGHLIGHTS

INTERFERENCE ON OPTUS TRANSPONDER

An 'interfering carrier' is recently reported to have caused disturbances to the operation of one of Optus' satellite transponders, used by the Civil Aviation Authority (CAA) for its national communications links between airfields. The carrier was apparently only present for short periods, and carried modulation which as yet has not been identified.

Some reports suggested that the interfering carrier could have been intentionally beamed at the satellite, by anti-social and irresponsible 'satellite hackers'.

However Mr Ian Boatman, chief executive of Optus' satellite division, while confirming that the interference had occurred, said that tests by Optus engineers had supported the alternative explanation: that it was much more likely to be caused by an unintentional emission from a legitimate satellite user.

Mr Boatman explained that although interference on satellite transponders was a rare and unusual problem, Optus had a number of techniques which could be used to identify the source of the interfering signals.

These included remote switching of the transponders between feed horns with different 'footprints', swinging ground station dishes and also arranging for individual users to make incremental changes to their transmitter power levels, at convenient times.

These tests were in progress at the time of writing, and had already shown that the source was coming from the eastern seaboard region. Further tests were expected to reveal the exact source 'soon'.

When asked about the possibility that the interference could have been intentional, Mr Boatman said he believed this was "virtually impossible" as it would require extremely sophisticated and costly equipment, including "a travelling wave tube producing at least 100 watts" plus an antenna dish "at least six metres in diameter".

However a satellite TV enthusiast recently reported picking up a high power microwave TWT at a scrap metal dealer near Sydney; the tube appeared to be complete and in working order, and when asked for a price, the dealer replied "$10".

One can only hope that six metre dishes are not also available from 'disposals' and scrap metal dealers, or Australia's satellite communications links may turn out to be less secure than users currently believe.

UK FIRM CLAIMS 150-MIN 'VIDEO CD'

Nimbus, a small CD production company based in Monmouth, Wales is reported to have found a system of recording information on a 12-cm compact disc at double the standard density, without using short-wavelength 'blue' lasers. The double-density discs are claimed to be compatible with many existing audio players.

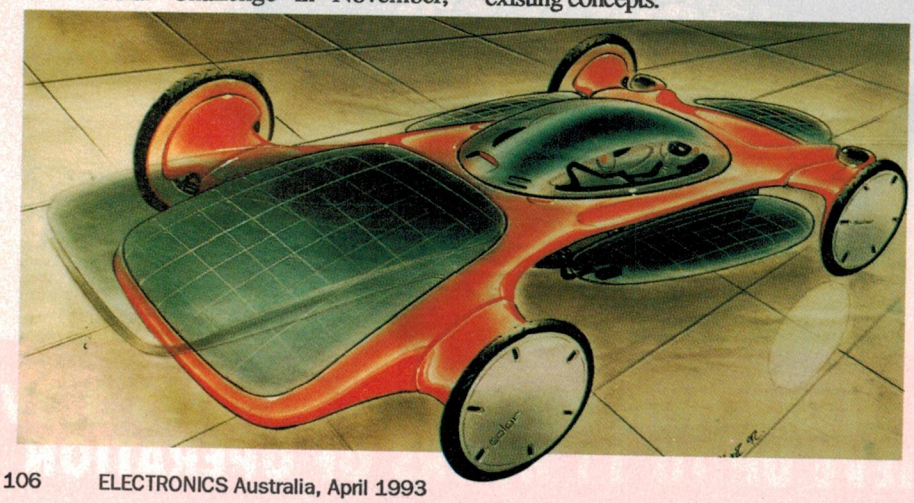
The firm says that it expects to have a video version of its double-density disc available within a year, with the ability to play up to 150 minutes of colour video with stereo sound. The quoted price for an adaptor to allow movies to be played back through a standard TV receiver is 'around £100'.

NEW AUSSIE SOLAR CAR

In what is claimed to be a milestone design akin to the famous 'winged keel' of America's Cup racing, the latest racer from Geelong-based Aurora Vehicles defies conventional wisdom in a bid to achieve performance previously known in solar racing.

With continuing development and just a little luck, the new Aurora design is planned to snatch victory in the 1993 World Solar Challenge in November, from a fleet of multi-million dollar Japanese, European and American entries.

The Aurora team took second place in the inaugural Solar Challenge in 1987, and sixth in 1990, against foreign giants such as General Motors and Honda. But this time it expects to leave overseas designs trailing in its slick but silent wake. Team leader Viv Baddeley said the key to Aurora's hoped-for success lay in originating a whole new design concept, whereas many big-budget entries were simply developing variations of existing concepts.

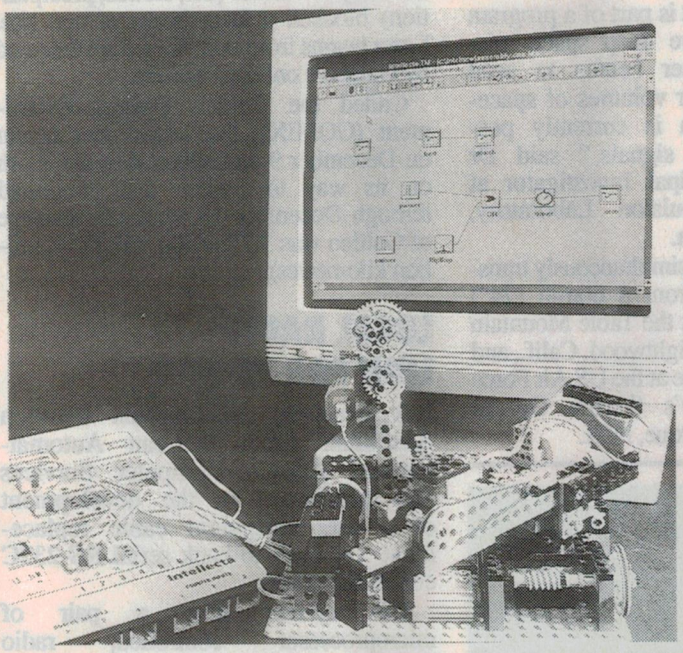


"After General Motors won the first Solar Challenge in 1987 with its 'cockroach shape' Sunraycer, most of the Japanese developed cockroach copies," he said. "Second time around, the winner was Switzerland's Spirit of Biel, with its 'inverted aerofoil' shape, and the Japanese are now pouring their millions into copies of this car — Japan's two biggest car makers have already unveiled remarkably similar cars."

"We believe our new car, which has several other critical design advantages in addition to its totally new shape, can and will outperform its foreign rivals — and will do so without the benefit of a multi-million dollar budget."

Unlike most other solar racing teams, Aurora is a purely private venture which began as a Ford-backed entry in the first Solar Challenge, and thrives on a contribution of ingenuity, hard work and background financial support from Ford and other sponsors. Most team members are either present or former Ford employees from Geelong, and their success with innovative technology shows that Australian industry harbours the design genius to lead the world in high-tech engineering.

WINDOWS-BASED CONTROL, ACQUISITION



A small start-up company in South Australia, associated with the University of South Australia, has produced a novel combined hardware/software package which allows very convenient demonstrations of real-world control and data acquisition, using an IBM-compatible personal computer running Windows 3.0 or higher. The *Intellecta* package combines a half-sized interface card and connection panel with a Windows-supported software package that allows motors, lights, sensors, switches and other hardware to be monitored and manipulated very easily and intuitively using on-screen icons and other graphics objects.

The Intellecta interfacing card provides four bi-directional motor drivers, four eight-bit 0-5V DC analog voltage inputs, two analog outputs (-10V to +10V or -5V/+5V, or -2.5V/+2.5V), eight digital switch inputs, eight digital outputs (5V/100mA drive capability), an on-board switchmode supply for the motor drivers, and three crystal-derived timer channels.

Connected to the card via a 50-way ribbon cable is an interface panel, allowing convenient connection to all of the input and output facilities. This provides 2mm socket arrays, with LEDs to indicate status.

The accompanying software package allows hardware connected to these inputs and outputs to be configured into control and data acquisition systems simply by placing and linking graphics icons, and then defining the attributes of the icons. Diagnostic icons representing logic probes and analog indicators are also provided, to allow ready analysis of system operation. Data analysis can also be carried out, by porting the system data to Microsoft's *Excel* spreadsheet package.

The Intellecta package requires DOS 3.3 or higher, with hard and floppy disks, at least 1MB of RAM and a mouse, and of course Windows 3.0 or higher. An AT or faster computer is recommended, with 2MB RAM and with EGA or VGA.

The package is price at $1300, including interface card and panel, software, photoresistor probe, thermistor probe and light gate, *Excel 3.0*, manual and full instructions. A demonstration package including a demo disk is also available, along with further information, from Intellecta Technologies, c/- School of Applied Physics, University of South Australia, The Levels, 5095; phone (08) 302 3356, or fax (08) 302 3389.

NEW LOCAL MAKER OF FLOPPY DISKS

'Media Labs', a subsidiary of Victorian computer distributor S.R. Electronics, has announced that it will shortly begin local manufacture of 3.5" floppy disks, in both 2DD and 2HD formats.

At a later date the company plans to produce 2.88MB and 'floptical' disks as well. The disks will be marketed under the Media Labs brand name, and are claimed to attain 90% local content due to local assembly and packaging.

Disks will also be available with OEM labelling, in bulk or unbranded. The firm says the disks will use high quality TDK and 3M media, and can be supplied in either unformatted form or pre-formatted for customer convenience to suit IBM, Apple, Amiga etc.

S.R. Electronics is distributor for the Tatung range of PC's, monitors and satellite TV reception equipment.

WINNER OF H-P SUBS PROMOTION

The lucky winner of our Hewlett-Packard/*Electronics Australia* subscriptions promotion, which ran from October 1992 to January 1993 inclusive, was Mr Michael Fry of 19 Karl Langer Crescent, Mt Pleasant, Queensland.

Mr Fry has won an HP 54600A 100MHz digital sampling oscilloscope valued at $3900, an HP 34401A precision 6.5-digit benchtop digital multimeter worth $1600, an HP 4263A precision four terminal digital LCR meter valued at $5500, an HP E3610A regulated DC bench supply worth $460 and an HP E2373A 3.5-digit handheld digital multimeter, worth $150. The total value of his prize is thus over $11,500.

Our congratulations to Mr Fry on winning this superb collection of high quality Hewlett-Packard test instruments, and our thanks to H-P Australia for sponsoring the promotion for the benefit of *Electronics Australia* subscribers.

NEW MOTOROLA PLANT IN IRELAND

Motorola has opened a new manufacturing plant in Swords, on the outskirts of Dublin in Ireland. The new plant is 103,000 square feet, built on a 55-acre site and is the first phase of an investment program valued at £30 million.

Products being manufactured at the new plant include two-way radios, pagers, battery power packs and accessories. The facility is planned to become Motorola's European manufacturing base for an expanding range of new products.

Motorola has operated a Software Centre in Cork for the last 10 years. The Cork facility employs over 100 engineers, developing software for digital cellular radio.

ADCNET BUYS LOCAL COMMS EQUIPMENT

The Australian Department of Foreign Affairs and Trade (DFAT) has signed a three-year contract with Queensland-based Cypher Research Laboratories, for the supply of its locally made IF921 Tempest Fibre-Optic Line Drivers. The equipment is to be used in the Australian Diplomatic Communications Network (ADCNET), a secure communications and message processing system linking diplomatic facilities.

The contract also includes non-tempest modems, crypto interface products, racks, power supplies and other options. The equipment is to be fitted to approximately 85 diplomatic posts internationally, with a major switching centre in Canberra and major hubs in London and Washington.

Prior to this contract, products of the type concerned were purchased exclusively from the USA. CRL's base product was more capable and 40%

cheaper than imported items, while also being available up to eight weeks faster due to local manufacture.

CRL has also signed a contract with the Royal Australian Navy, to supply a quantity of KU892 Combat Data Terminals. The Cycom terminals will be fitted to Fremantle class patrol boats.

LASER CONTACT OVER 2.2M KMS!

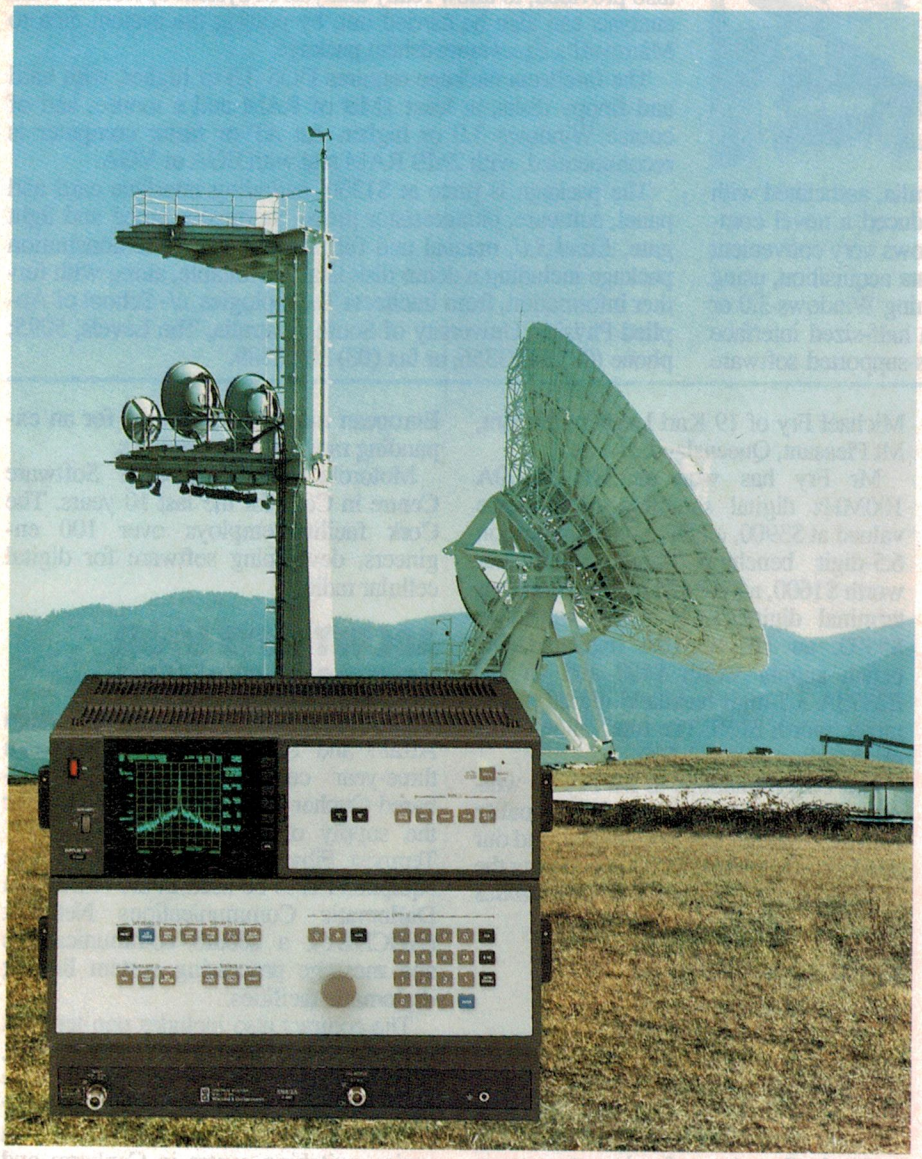
A major milestone in space communications was achieved recently when NASA scientists successfully transmitted laser signals to the Galileo spacecraft at a distance of 1.3 million miles (2.2 million kilometres).

"This experiment is part of a program to show that future deep space missions can use laser beams to send back to Earth larger volumes of space-acquired data than is currently possible using radio signals," said Dr James Lesh, Principal Investigator at NASA's Jet Propulsion Laboratory, Pasadena, California.

Laser beams were simultaneously transmitted to Galileo from a 60mm (24") diameter telescope at the Table Mountain Observatory near Wrightwood, Calif., and a 1.5m (60") telescope at the US Air Force Phillips Laboratory's Starfire Optical Range near Albuquerque, N.M.

Two sites were used to provide signal diversity if weather (i.e., clouds, precipitation) blocked a laser beam at one site. Laser beams from both sites were detected by Galileo's onboard camera.

Called the Galileo Optical Experiment (GOPEX), the experiment began on December 9 as Galileo flew by Earth on its way to Jupiter, and continued through December 16 when the distance of Galileo was 3.7 million miles (six million kilometres).



Wandel & Goltermann's new SNA-7A microwave spectrum analyser has a frequency range extending from 50Hz right up to 22GHz, and is intended for acceptance testing and monitoring of Earth station systems. It has high input sensitivity and also very low intrinsic noise level — even in the 20GHz band the intrinsic noise level is only -127dBm with 3Hz resolution bandwidth.

LOCAL RADIO LINK FOR RS-232

A two-year collaboration between Australian firms McLean Automation and Adolon Computer Services has culminated in the development of a user-transparent cable replacement for back-to-back serial RS-232C communications.

The system uses a pair of microprocessor controlled, radio licence exempt digital transceivers, configured to run half-duplex telemetry between two RS-232C ports.

With forward error correction and data encryption built into the firmware, the system is capable of sustaining 2400bps throughput over several kilometres.

The low power design is targeted mainly at the area of proximal data transfer between data loggers, PLC's and host PC's.

A user-configurable on-board EEPROM can be used to access broadcast and other options if required. Further information is available from Kris McLean on (045) 79 6365.

'FASTEST' SILICON BIPOLAR TRANSISTORS

The fastest silicon bipolar transistors in the world are claimed to have been produced in Siemens' central research laboratories, using new transistor concepts and new methods of depositing thin layers.

The performance of the new transistors is achieved by depositing thin layers of silicon — not over an entire surface as before — but only at predefined locations.

If the electrically active part of a bipolar transistor is manufactured using this process know as *selective epitaxial growth* (SEG), very flat collector and base regions with extremely steep dopant profiles can be obtained due to the substantially reduced temperature loading.

In addition, there is very little overlapping of the base with the collector and

emitter and the corresponding parasitic capacitances are minimised.

The functionality of arrays with more than 500,000 transistors is proof that this technology can be manufactured.

Ring oscillators employing usual design rules, 1 x 200mV swing, and an emitter area of 1um^2 have achieved a gate delay of 18ps at 1.6mW power per gate.

The extremely short switching times are said to result from the excellent high-current performance of the new transistors. Up to a collector current density of around 1.6mA/um^2, the cut off frequency never falls below 44GHz. A non-optimised static frequency divider achieved, at the first attempt, a new best-ever performance for silicon transistors of 23GHz.

The record figures were made public for the first time at the latest IEDM conference in San Francisco, USA.

NEWS BRIEFS

- The ***Microelectronics Conference 1993*** will be held at the Gold Coast, Queensland in September-October. Papers will be selected from a broad area covering Design, Tools, Automation, Marketing, Manufacturing, etc. For more information contact IREE Australia, PO Box 79, Edgecliff 2027; phone (02) 327 4822, fax 362 3229.
- The two companies, ***Dick Smith Electronics*** and ***Dick Smith (Wholesale)***, have interchanged their names. This means that Dick Smith (Wholesale) is now ACN 000 445 956, and Dick Smith Electronics is ACN 000 908 716. Neither company has altered its activities nor its make-up.
- ***Marconi Instruments*** has won an order for 350 units of its new 6960B RF power meters and sensors from the UK Ministry of Defence. They will be used by the Royal Navy and British Army. The 6960 is the standard RF and Microwave Power Meter for the Australian Navy.
- ***Austel*** has appointed Mr Rick Campbell as Chief Operating Officer, Mr John MacMahon as General Manager of Consumer Affairs, and Ms Lesley Gordan as General Manager, Corporate Resources. Ms Amanda Davis, previous GM, Consumer Affairs, is now acting in a new position of Projects Director.
- ***Datacraft*** has opened a new office in Taikoo Shing, Hong Kong, as headquarters for its Asian and China operations.
- Mr David Rigg has been appointed as Marketing Director of ***Apple Computer Australia***.
- ***Independent Information Technology Training*** is offering a three-day 'Network Cabling Design' course to be held twice at the Maritime Conference Centre in Sydney, March 22-24 and July 12-14, and also at the Sheraton Hotel, Melbourne, April 5-7 and November 8-10. For more information contact ITT Training, PO Box 1007, North Sydney 2059; phone (02) 959 5990, fax 956 6375. ❖

SRA ORDERS RADIO COMMS WORTH $10M

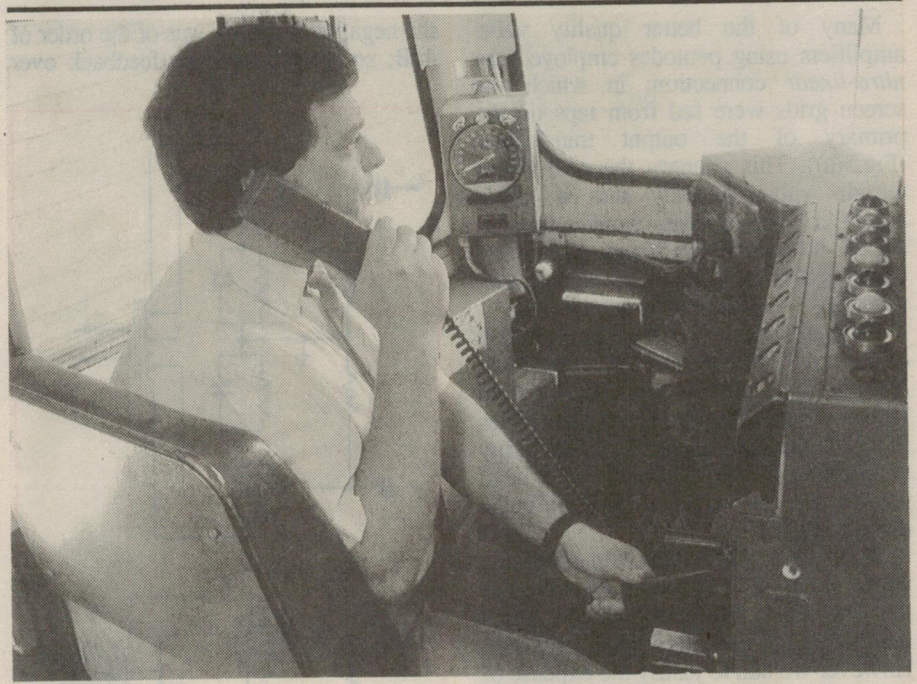
The State Rail Authority (SRA) of NSW has signed a $10 million contract with Philips to provide a state-wide voice and data radio communications network for its locomotives — as far as Albury and Brisbane, and as far west as Broken Hill — using 165 base sites throughout NSW. It replaces an aging pole mounted track side telephone system and some smaller regional radio systems which are the existing communication system to trains.

NSW Minister for Transport, Mr Bruce Baird, said that the installation of modern radio communication links with locomotives will enhance SRA's competitiveness in the freight business, with improved safety procedures.

Installation of the new SRA network, which will totally upgrade radio communications along much of the 7500 kilometres of track is planned to begin in August 1993 and should be completed during 1994.

General manager of Philips Mobile Communications System, Mr Mike Tester, stated that the network will have almost 100% local content. "Almost all the equipment is designed and manufactured in Australia."

Philips' Adelaide plant will produce 1430 mobile units for installation in the locomotives. ANSA Pty Ltd based in Brisbane, a major subcontractor to Philips, will supply 510 digital switches. ERG, based in Perth will produce 350 high powered 50-watt base stations, while AUSPACE, a high tech innovator in satellite-borne equipment based in Canberra, will supply 290 GPS satellite receivers and Westinghouse Brake and Signal from Sydney will supply installation services for the locomotives.



The Philips radio system will give fast, reliable communication between train controllers and train drivers. The train drivers will have a much greater degree of safety and security than was previously possible.

For example, in the event of an emergency the driver can push an emergency button and be in instantaneous contact with the controller, taking priority over other traffic on the network. Knowing exactly where the train is located, the controller can render assistance quickly and accurately.

A number of separate UHF transceivers fitted to each locomotive allow the driver to communicate with other passing trains or track side personnel, the Freight Rail Train Control Centre Operator, and in the future, with the proposed City Rail network in the Sydney metropolitan area.

In addition the driver is able to leave the locomotive and communicate with his controller using a hand portable radio. If required the driver can also be patched through to the telephone nework by the controller to allow contact with anyone within the SRA Organisation, or with other services in the case of a emergency.

Each locomotive will have a GPS (Global Positioning System) satellite receiver which will pass location information to the onboard computer.

This information will be passed via the radio data network to the Train Controller's Work Station and will show the location of the locomotive anywhere in NSW with a high degree of accuracy. ❖

More advice from an experienced engineer:

Some thoughts on the design of Valve Audio Amplifiers - 2

In this second article offering *EA*'s readers the benefit of his wide experience in amplifier design, the author discusses ultra-linear operation and alternative ways in which it can be achieved; output transformers; phase-splitter stages; and the use of a Zobel network to stabilise loading on the output stage. He also presents a low-powered amplifier design which illustrates many of the points discussed in both articles.

by NEVILLE THIELE B.E., F.I.E.(Aust.), F.I.R.E.E. (Aust.), F.A.E.S.

Many of the better quality valve amplifiers using pentodes employed the *ultra-linear* connection, in which the screen grids were fed from taps on the primary of the output transformer (Fig.5(a)). This changes the pentode or tetrode valve partially into a triode amplifier. The change would, for example, be total if the screen grids were connected to the tops of the transformer winding — i.e., tied to the anodes.

This 'ultra-linear' configuration is one of the many brilliant innovations in sound and television circuits produced by Alan Dower Blumlein at the EMI Laboratories in the 1930's, and I defer to no one in my admiration of him. Nevertheless it need not be the only way of producing the desired result.

When the amplifier was being designed whose paralysis tests were described in the first article, we seriously considered incorporating the ultra-linear scheme. However we had to justify the expense of bringing out extra taps from the transformer primary, and face the notorious problems of phase shift between the anodes and screen grids caused by leakage inductance and self-capacitance in the transformer.

For a start, we asked ourselves, what exactly *was* the magic of the ultra-linear connection — was it merely a form of local feedback around the output stage? We therefore decided to compare the use of 'ultra-linear' negative feedback into the screen grids with negative feedback into the cathodes; i.e., effectively into the control grids (Fig.5(b)). After all a suitable winding was already provided on the transformer, namely the one feeding the loudspeaker.

With the 15-ohm loudspeaker winding centre-tapped to feed the two cathodes, the negative feedback was of the order of 4dB; so we adjusted the feedback over two otherwise identical amplifiers to the same overall figure of 15dB (quite a respectable value for commercial amplifiers in those days) and then compared their distortion figures. The amplifier with cathode feedback gave lower distortion, by a small but perceptible margin.

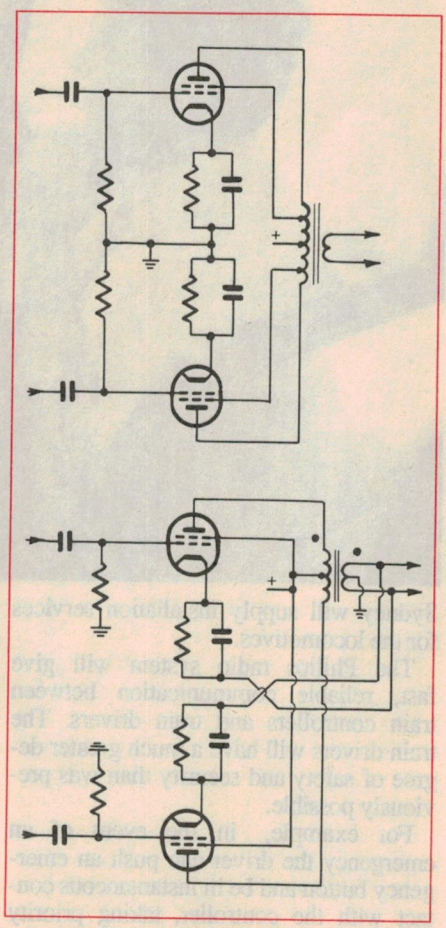


Fig.5: The more usual configuration for ultra-linear output stage operation is shown in (a), where the screen grids are connected to taps on the output transformer primary. But a very similar result can be achieved by local negative feedback to the cathodes, as shown in (b).

Thus a better result was achieved, without complicating the transformer design or any more expense than through centre-tapping the transformer secondary. Because this 'feedback winding' was at such a low impedance, self capacitance problems were absent.

Again this is only one test, but it indicates that cathode feedback, an ultra-linear method of its own kind (due also to Blumlein if I remember aright) and used also in a highly regarded Quad amplifier designed by Peter Walker, is worth trying before accepting the more difficult and expensive variation using feedback via the screen grid.

Output transformers

Transformers, for matching the output impedance of the load (usually a loudspeaker) to the impedance into which the amplifier best performs, are used almost universally in valve amplifiers and only rarely for transistor amplifiers. Transformers need a ferromagnetic core to deliver a reasonable balance of output vs. distortion at low frequencies. However the performance depends on the permeability of the core, a 'constant' that varies considerably in fact with signal level; that is, in other words, non-linear.

A great advantage of push-pull over single-ended operation in valve amplifiers is that it reduces the DC excitation of the transformer core to virtually zero, the anode currents producing equal and opposite DC excitations. But even so,

the permeability of transformer steel to AC signals can vary up to 10 times with the signal level and that means, of course, that transformers generate third harmonic distortion at low frequencies.

Another problem is that incomplete coupling between the primary and secondary windings produces leakage inductance, which attenuates the high frequencies.

For a given geometry of construction the ratio of primary inductance to leakage inductance is constant, so that if the primary inductance is increased to improve the low frequency response, the leakage inductance inevitably increases in the same proportion and worsens the high frequency response.

The leakage inductance can be reduced by dividing the primary and secondary into smaller sections and interleaving them. This produces better coupling, but it also divides the self-capacitance of the winding into sections and produces a multi- section low pass filter, whose more rapid phase change at high frequencies makes large and stable negative feedback harder to achieve.

Output transformer design is a fascinating exercise, because it requires the balancing of so many competing factors. Nevertheless a good output transformer will always be large, heavy and expensive, and even then it is still worse than a direct connection. A transistor amplifier, on the other hand does just this.

In fact, one of the finest valve amplifiers that I have heard used 6AS7's — dual low-impedance triodes intended for voltage regulated power supplies — configured in the same manner as has become conventional in transistor amplifiers, described in those days as 'single-ended push-pull'. The amplifier used three triode valves in parallel on the top and another three on the bottom, and fed a 15-ohm loudspeaker directly, thus eliminating any need of a transformer.

The Murray 'long thin' amplifier of grateful memory was configured similarly, but it used two conventional valves — one on top, one below — and needed a loudspeaker with an 800- ohm voice coil, which was made specially by Magnavox and Philips.

Phase splitters

The easiest and most popular way of deriving the two signals in opposite phase, to drive a push-pull output stage, was the 'concertina' phase splitter. Why 'concertina'? I never found out, but guessed that it might have been because a concertina (similar to a small accordion) was sometimes known as a 'pushme-pullyou'.

The circuit, shown in Fig.6(a) is simple, needing only anode and cathode loads of equal resistance, thus providing near unity gain to each of the outputs. However, its undistorted voltage excursion was somewhat limited, which could be a disadvantage when comparatively large drive voltages were needed — for example by triode output stages, or pentodes with large cathode feedback, or ultimately by the Macintosh amplifier whose output primary winding was split equally between the anode and cathode circuits of the output stage.

However the concertina phase splitter had the greater disadvantage that once the grid of the lower output valve was driven into conduction, it thus produced an instantaneous bypass on the cathode of the phase splitter, which thus delivered its full gain, between 15 and 50, to the top output valve — producing a waveform similar to the negative excursion of Fig.2(d).

Probably for these reasons, the highly regarded Williamson amplifier of the late 1940's interposed a push-pull resistance coupled driver stage between the concertina phase splitter and the output stage.

Why not use the cathode-coupled amplifier long-tailed pair, so commonly used in transistor amplifiers? Simply because, unless the HT voltage is greater than 250 volts, the DC drop across the cathode resistor or 'tail' would have taken up more of the precious HT voltage and limited even further the drive voltage for the output stages. (It should be remembered that in few valves could the anode to cathode excursion go below 50V, sometimes 70V, and that negative HT rails were usually considered an unnecessary expense.)

The other possibility was the 'paraphase' splitter, of Fig.6(b). In its simplest form, the drive voltage for the top output valve is attenuated and fed to the driver for the second valve, in the same ratio as the gain of that driver. Thus the lower valve receives a drive voltage with the same amplitude as, but opposite in phase to, that for the top valve. However the accuracy of balance between the two drive signals then depends on the tolerances of the two resistors of the attenuation network and on the gain of the lower driver stage, which can vary considerably from valve to valve.

That gain variation could be reduced by the use of 'floating paraphase', in which the grid of the lower driver is fed by two equal resistances — R1 and R2 in Fig.6(c) — from the outputs of both the top and bottom drivers. Then when A is the gain of the lower driver, its output voltage is -A/(A + 2) times that of the top driver; e.g., -50/52 or -0.96, when A is 50.

However when the output valves are driven to clipping and their grids conduct, the grid of the lower driver then receives the full DC voltage offset built up in the coupling capacitors — and because its 'grid-base', roughly its bias voltage, is

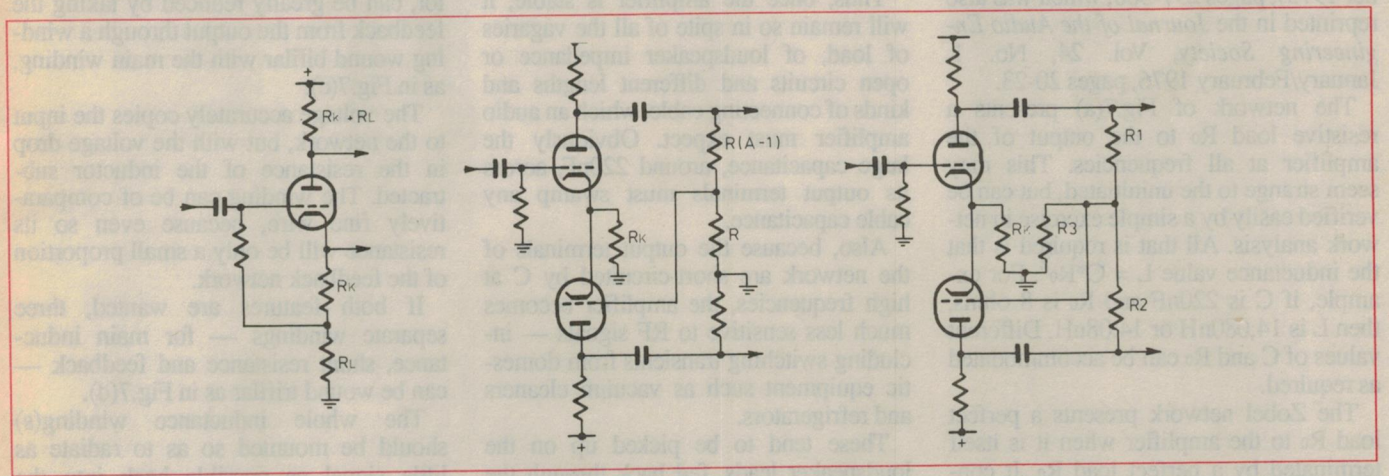


Fig.6: Various phase splitters used in valve amplfiers. Shown in (a) is the 'concertina' type; (b) the 'paraphase' type; and (c) the 'floating paraphase' type.

much smaller, it paralyses much more readily than the output stage.

A compromise solution is to choose R2 in Fig.6(c) a little greater than R1, and to add R3 shunting the input to the second driver. Then for equal drive voltages

$R3 = R1*R2/[(A-1)*R2 - (A+1)*R1)]$

In practice the resistance R2 could be chosen as the next E6 tolerance value above — i.e., about 1.5 times — the value of R1. For example, if A is 50, R1 is 330k and R2 is 470k, then R3 is 25k.

The *Radiotron Designer's Handbook* sets forth a number of other phase-splitting circuits, but those above are the ones most likely to be encountered.

It is tempting to wonder why valves such as the 6CM5, a television line output pentode, or the 807, a general purpose power tetrode with characteristics similar to the KT66, are not more popular in audio amplifiers. The anode connections to both are made through a top cap, which eliminates the danger of high voltage flashover from anode to filament that can occur on octal sockets, even those with bodies moulded from alkyd plastic or porcelain.

Of course there are also dangers when the top cap carries a high voltage. *Wireless Weekly* once carried a cartoon with the caption 'Famous last words — I didn't know that the 807 had a grid cap'.

Zobel network

In that context, a Zobel network between the secondary of the output transformer and the output terminals should ensure much safer and more reliable operation. I described this technique in the paper 'Load Stabilising Networks for Audio Amplifiers', in *Proceedings of the IREE Australia*, Vol. 36, No. 9 (September 1975), pages 297-300, which was also reprinted in the *Journal of the Audio Engineering Society*, Vol. 24, No. 1, January/February 1976, pages 20-23.

The network of Fig.7(a) presents a resistive load R_o to the output of the amplifier at all frequencies. This may seem strange to the uninitiated, but can be verified easily by a simple exercise in network analysis. All that is required is that the inductance value $L = C*R_o^2$. For example, if C is 220nF and R_o is 8 ohms, then L is 14,080nH or 14.08uH. Different values of C and R_o can be accommodated as required.

The Zobel network presents a perfect load R_o to the amplifier when it is itself terminated by a perfect load R_o. It continues to present a reasonable load to the amplifier at high frequencies even when

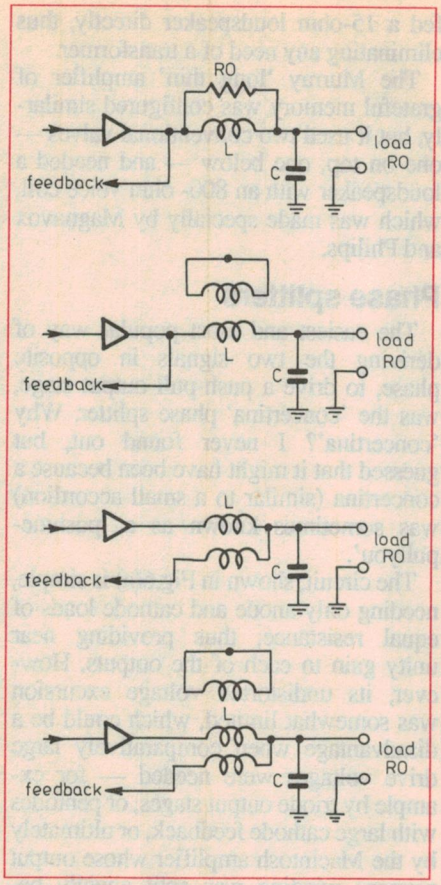


Fig.7: The basic realisation of a Zobel network, for stabilising the loading on the output stage, is shown in (a). However an alternative realisation using a shorted resistive bifilar winding is shown in (b). Any detrimental effect on speaker damping can be obviated by taking the feedback via a bifilar winding (c), while the ideas of (b) and (c) can be combined as in (d).

the load is very different from R_o, and of course it will always present exactly R_o *regardless of the load*, when the frequency is high enough.

Thus, once the amplifier is stable, it will remain so in spite of all the vagaries of load, of loudspeaker impedance or open circuits and different lengths and kinds of connecting cable, which an audio amplifier must expect. Obviously the large capacitance, around 220nF, across its output terminals must swamp any cable capacitance.

Also, because the output terminals of the network are short-circuited by C at high frequencies, the amplifier becomes much less sensitive to RF signals — including switching transients from domestic equipment such as vacuum cleaners and refrigerators.

These tend to be picked up on the loudspeaker leads, fed back through the feedback resistor (often obligingly shunted with a small capacitor) and detected at the base-emitter junction (or the grid) at the first stage of the amplifier — whence they appear as spurious audio in the output.

Some designers dislike the Zobel network, because they believe that it spoils the square wave performance of their amplifiers. But the network is really external to the amplifier proper. It should be thought of rather as a part of the loudspeaker, which just happens to be mounted within the amplifier — a first-order crossover network that crosses over from the loudspeaker proper to a 'mute tweeter' (namely the resistance R_o) at very high frequencies.

It crosses over, and attenuates the loudspeaker response by 3.0dB, at a frequency of $1/2\pi C*R_o$. It attenuates by 0.3dB at a frequency of $1/8\pi C*R_o$. For example, when C is 220nF and R_o is 8 ohms, those frequencies are 91kHz and 23kHz respectively — hardly a serious impairment to a loudspeaker's performance. The amplifier's true square wave response is seen at the INPUT to the network.

If an amplifier with this network DOES oscillate at a high frequency, such as through taking an unshielded input lead close to the output lead (which I am ashamed to admit I have done myself), then its whole output power goes to the resistor R_o which shunts the inductance. That resistor needs therefore to be robust. It could be realised by a winding of resistance wire with resistance R_o, wound bifilar with the main winding and with its ends connected together, as in Fig.7(b). A suitable material is constantan, which has a resistivity 28 times that of copper and solders much more easily than nichrome.

As a separate issue, the small additional resistance that the main inductance winding inserts in series with the loudspeaker load, and thus worsens the damping factor, can be greatly reduced by taking the feedback from the output through a winding wound bifilar with the main winding, as in Fig.7(c).

The voltage accurately copies the input to the network, but with the voltage drop in the resistance of the inductor subtracted. The winding can be of comparatively fine wire, because even so its resistance will be only a small proportion of the feedback network.

If both features are wanted, three separate windings — for main inductance, shunt resistance and feedback — can be wound trifilar as in Fig.7(d).

The whole inductance winding(s) should be mounted so as to radiate as little signal as possible back into the amplifier. Ideally it would be wound as a toroid, but with suitable care a

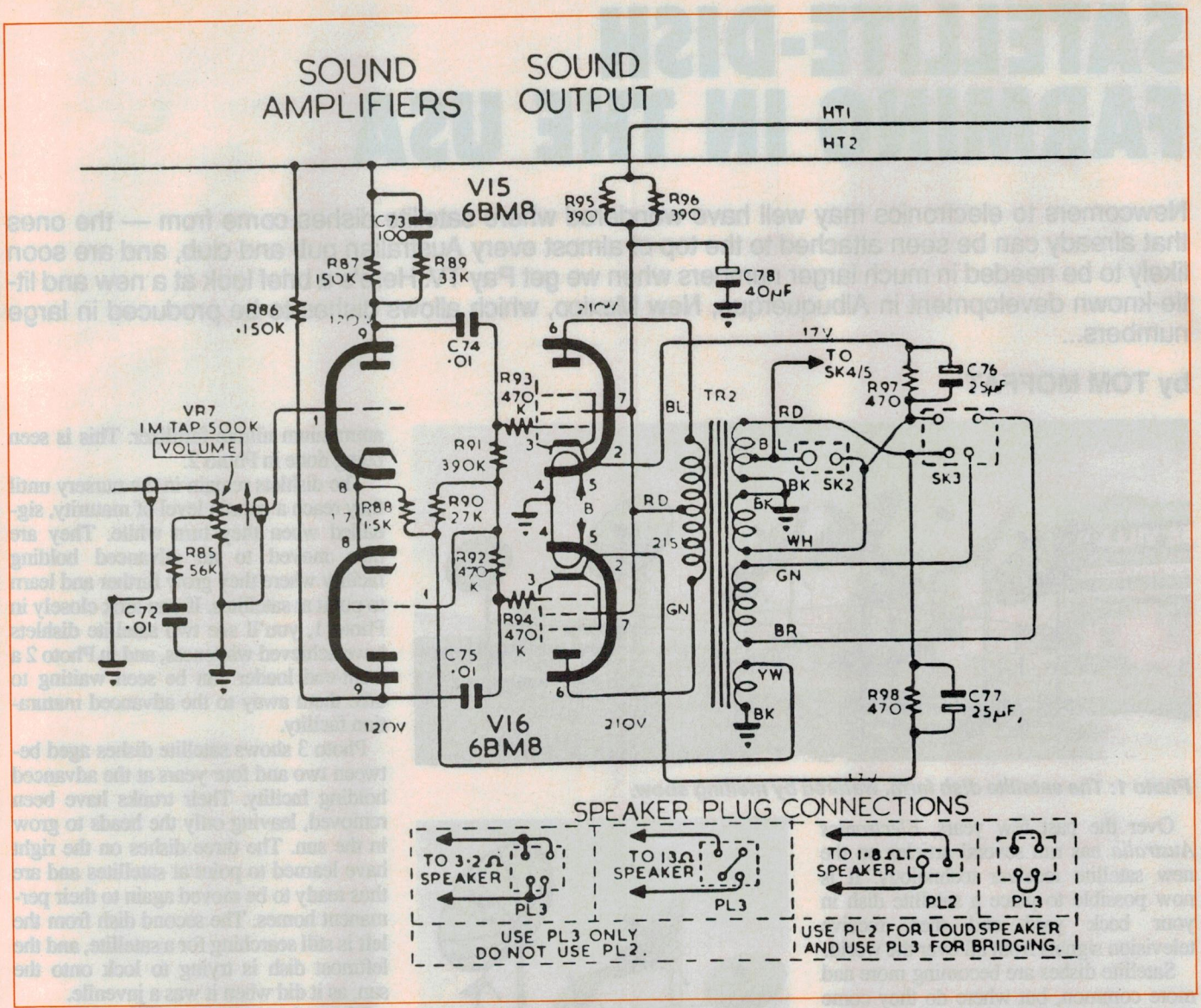


Fig.8: Schematic of the audio output amplifier designed by the author for the HMV F-series television receiver of 1957, which incorporates many of the points discussed in this article.

simpler construction, such as a solenoid, is perfectly satisfactory.

This scheme was devised to stabilise the operation of transistor amplifiers. I have not tried it in valve amplifiers, but it should be even more useful there, where the consequences of oscillation can be even more destructive and expensive.

I was unable to ascertain whether 6CM5's or 807's were available in the USA, but EL34's were readily available — made in China, Romania and Czechoslovakia. In particular, Czech valves cost $50 with clear glass envelopes, but $60 with envelopes of blue Bohemia glass. Do they make an audible difference?

Conclusion

These articles have not sought to provide a complete guide to the design of valve amplifiers. That would require a whole book, such as the monumental fourth and last edition of the *Radiotron Designer's Handbook*, edited by Fritz Langford-Smith (published by the Amalgamated Wireless Valve Company in 1952 and reprinted by Iliffe in England in 1955).

Rather, the object has been to throw light on some aspects that are important to good design but are not usually discussed. Some of these, such as the considerations of paralysis after overload, apply equally to valve and transistor amplifiers.

As a final example I offer the amplifier of Fig.8, the sound output stage of the 1957 television receiver, which incorporates the ideas enumerated above. The only additional point to note is that the overall feedback from the transformer secondary is applied to what would otherwise be a common earth for both the two triode input stages.

The overall feedback is required for the upper triode only. It does not affect the lower triode, which is a floating paraphase stage that also floats on the feedback voltage.

The estimated increase in factory cost for this push-pull amplifier over a single-ended stage using the same valve type was 15 shillings, being the cost of an extra valve and socket, one paper capacitor and five resistors. The output transformer was the same size as for a single-ended stage, the core being able to handle the extra output power because no special air gap was required to take care of DC magnetisation.

The transformer construction was the same, except for bringing out one tap on the primary winding. The overall negative feedback was taken from a separate secondary winding, as in the comparable single-ended stage. ❖

SATELLITE-DISH FARMING IN THE USA

Newcomers to electronics may well have wondered where satellite dishes come from — the ones that already can be seen attached to the top of almost every Australian pub and club, and are soon likely to be needed in much larger numbers when we get Pay TV. Here's a brief look at a new and little-known development in Albuquerque, New Mexico, which allows dishes to be produced in large numbers...

by TOM MOFFAT

Photo 1: The satellite dish farm, watered by melting snow.

Over the past few years, *Electronics Australia* has run several articles on the new satellite receiver technology. It is now possible to place a satellite dish in your back yard and then receive television signals from all over the world.

Satellite dishes are becoming more and more common, but where do they come from? They don't just grow on trees, you know. Or do they? During a recent trip to the USA, your faithful correspondent, after much digging, discovered how satellite dishes are now being produced in that part of the world. Many dishes produced there are exported to Australia.

In a 'nursery' in an industrial section of Albuquerque, New Mexico, I discovered that satellite dishes are grown for eventual export. In an operation carefully supervised by the state Agriculture Department, seedlings are planted in a grassed compound where they are watered only by natural means — rain and melting snow.

Photo 1 shows a healthy crop of satellite dishes at about eight months of age. They have grown to around six metres tall, but have not yet been trained to point at satellites. So they are facing in more-or-less random directions, with some of the more mature dishes seeking the sun.

Two or three times a week, a team of itinerant Mexican labourers comes in to till the soil around the base of the satellite dish trunks. At this time they also feed the dishlets a mixture of copper sulphate and ammonium nitrate fertilizer. This is seen being done in Photo 2.

Photo 2: The dishlets are carefully tended to ensure robust health.

The dishlets remain in the nursery until they reach a certain level of maturity, signalled when they turn white. They are then moved to an advanced holding facility where they grow further and learn to point at satellites. If you look closely in Photo 1, you'll see two satellite dishlets have achieved whiteness, and in Photo 2 a front-end loader can be seen waiting to take them away to the advanced maturation facility.

Photo 3 shows satellite dishes aged between two and four years at the advanced holding facility. Their trunks have been removed, leaving only the heads to grow in the sun. The three dishes on the right have learned to point at satellites and are thus ready to be moved again to their permanent homes. The second dish from the left is still searching for a satellite, and the leftmost dish is trying to lock onto the sun, as it did when it was a juvenile.

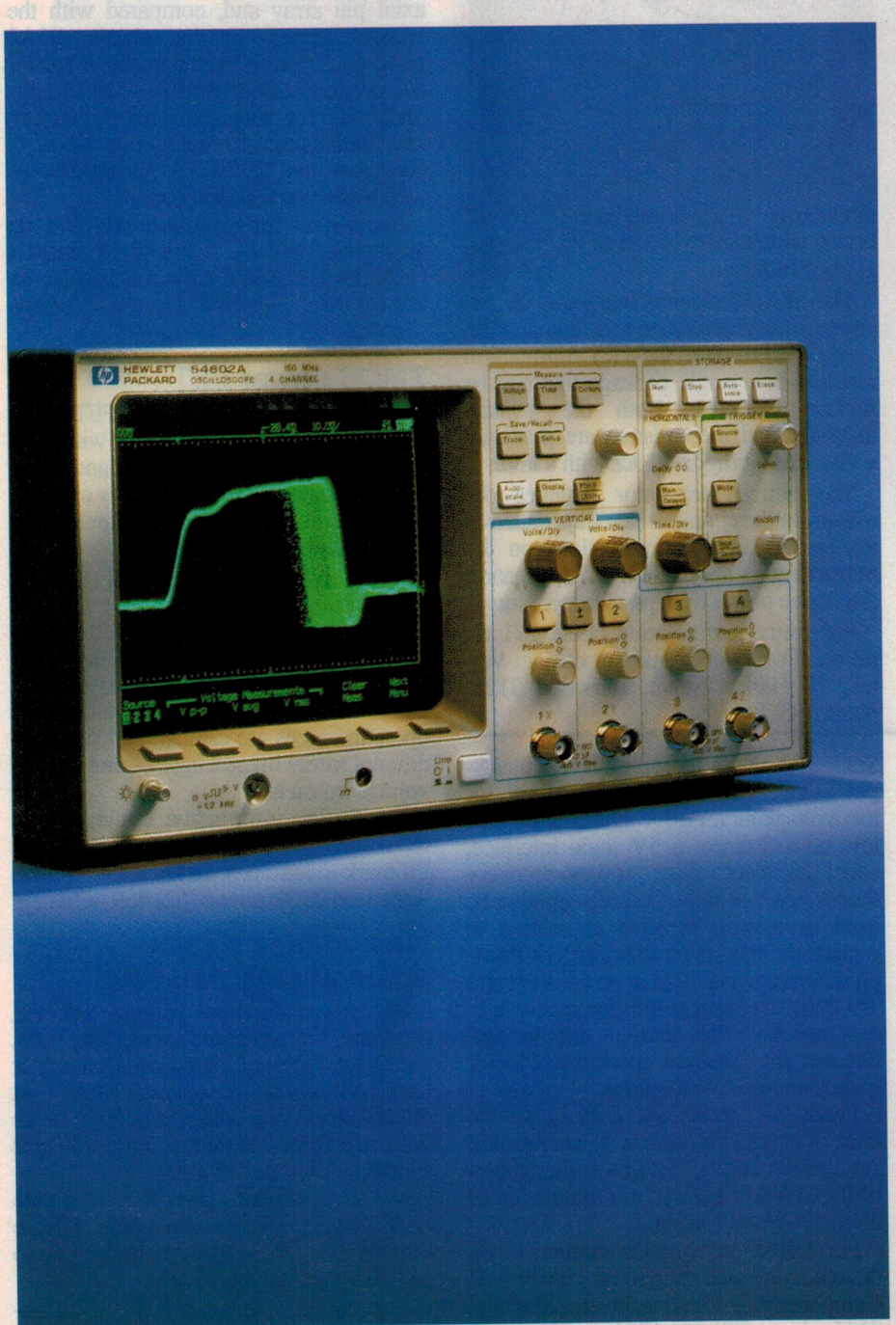
It's understood a satellite dish farm like this may soon be set up in Australia. The climate, particularly in the foothills of the Snowy Mountains, is very much like the dishes' native home in New Mexico. A satellite dish farm would provide much-needed export dollars for Australia's economy.

A generation ago not many people took Australia's wine industry seriously, but now it's a force to be reckoned with throughout the world. Primary industry experts now consider it very likely that satellite-dish farming could go the same way. ❖

Photo 3: Mature dishes learning to track satellites.

FFT and a scope for under $5,500

You Didn't Think You Could Afford HP, Did You? Think Again.

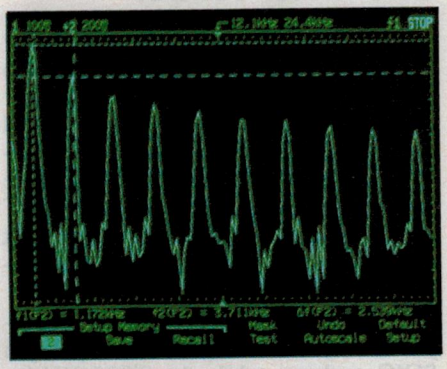


The value of this 100MHz scope is easy to see.

The HP54600 gives you superior viewing of virtually any waveform, even at low rep rates and slow sweep speeds. It looks and feels like an analog scope, with dedicated knobs and a display that responds instantly to your control changes. And it has the digital power that analog can't give you – high accuracy, automatic measurements, hard copy output and programmability.

But what really stands out is that all this performance costs just **$4,840** (4-channel) or **$4,170** (2-channel).* What's more, now through June 30, 1993, you can add FFT by purchasing an HP 54657A or 54658A Measurement/ Storage Module **for only $625.**

For more information call our customer information centre on 131347. We are happy to send you literature.

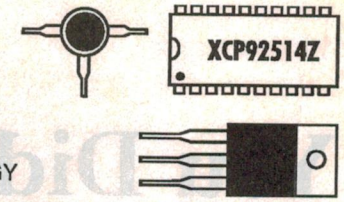


FFT is just one of the advanced waveform viewing tools you'll get with the HP54657A/58A Measurement Storage Module.

* PRICES EXCLUDE SALES TAX

HEWLETT PACKARD

Solid State Update



KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

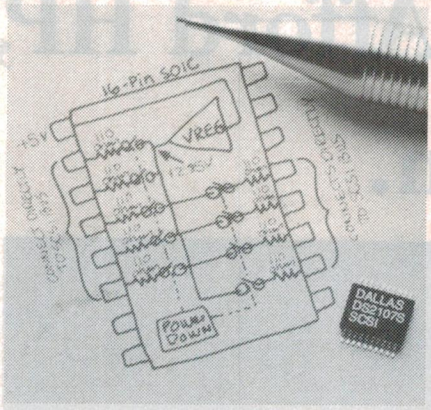
Active terminator for transmission lines

A new chip from Dallas Semiconductor can quieten transmission lines with precise termination. As the length of the SCSI bus increases to accommodate additional peripherals, the DS2107 SCSI Terminator can electrically move the termination point. Fully compliant with SCSI and SCSI-2 standards, the DS2107 connects and disconnects from the system bus under software control via a power-down pin.

Existing termination schemes plug a resistor SIP (Single In-line Package) into a socket on the PC board. When termination is no longer at the end of the bus because a peripheral has been added, the user must take apart the system and pull the resistor SIP out of its socket with pliers. To circumvent this problem, many disk drives and peripherals are made with no termination. These require the user to purchase and install an extra end plug.

The DS2107 monolithic IC is a non-mechanical solution to these problems. Now peripheral manufacturers can embed active termination that is turned on and off under software control, eliminating the need for the end user to unzipper the system or to purchase additional components.

The DS2107 provides active termination for nine signal lines. This X9



modularity accommodates SCVSI buses, which have 18, 26 or 45 lines actively terminated.

The all-CMOS chip integrates an accurate voltage reference and nine precise, switched 110-ohm (+/-1%) termination resistors in a single package that can be surface mounted. Both the voltage regulator and the resistors are precisely set by writing digital codes with a laser.

The active terminator matches the resistor to the characteristic impedance of the bus to eliminate reflections on the transmission lines. Active termination also saves power over passive technique.

For further information circle 271 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

SMD motor control

Siliconix has released three new MOSFET half-bridges, designed to reduce space requirements and lower assembly costs in small motor control applications. For motor control applications such as disk drives, one of these tiny devices replaces two MOSFET packages with one surface-mount part and allows the use of automated assembly techniques.

The Si9951DY is a monolithic complementary half-bridge in a tiny 8-pin SOIC package, while the Si9954DY includes two complementary 50V MOSPOWER chips in a 16-pin SOIC package. The Si9956DY includes two electrically isolated N-channel MOSFETs which can be configured as a half-bridge.

The use of n-channel MOSFETs greatly reduces the chip size, thus allowing the Si9956DY to be housed in the smaller 8-pin SOIC. The chips are optimised for low voltage motor drive applications with low on-resistance, a 5V logic interface, and intrinisic fast reverse-recovery diodes. Two or three devices can also be used as a cost effective alternative to replace the integrated H-bridges or three-phase drivers available in power SIPs and TO-220s. A copper leadframe specifically designed for this product family, optimises the thermal performance for board-mounted applications.

Leads are connected directly to the back of the die for improved heat transfer. As a result, continuous power dissipation of 2 to 4W and peak power dissipation of 50 to 100W are achieved.

For further information circle 276 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766.

SMD zeners

The silicon planar zener diode series BZT52C2U7...BZT52C51 from ITT Semiconductors are available in the SMD plastic package 60A2.

This SMD package allows for higher component density due to the axial pin array and, compared with the BZX84 series in its plastic 23A3 package (350mW), guarantees a higher power dissipation (410mW). Possible applications for this series are regulating and stabilising circuits in automotive, consumer and industrial electronics, as well as telecommunications.

For further information circle 273 on the reader service coupon or contact Crusader Electronic Components, 73-81 Princes Highway, St Peters 2044; phone (02) 316 3855.

TMOS power FET

The Motorola TMOS E-FET type MTP50N05E, is designed to withstand high energy in the avalanche and commutation modes. The new energy efficient design also offers a drain-to-source diode with a fast recovery time.

These devices are designed for low voltage, high speed switching applications in power supplies, converters and PWM motor controls. They are particularly well suited for bridge circuits, where diode speed and commutating safe operating areas are critical, and offer additional safety margin against unexpected voltage transients.

For further information circle 275 on the reader service coupon or contact VSI Promark Electronics, 16 Dickson Avenue, Artarmon 2064; phone (02) 439 4655.

Line voltage automatically selected

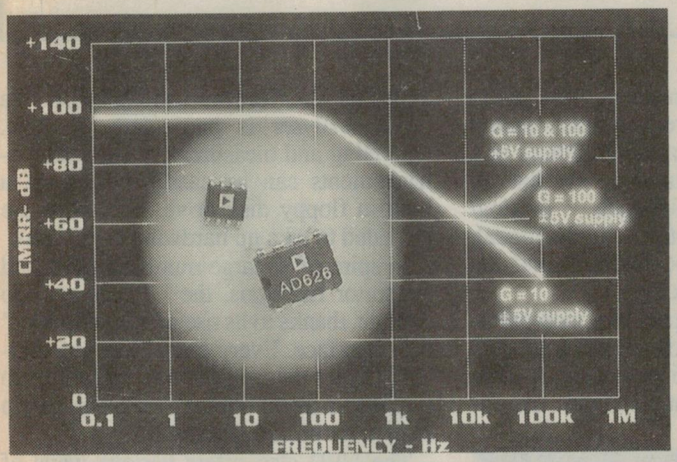
An automatic line voltage selector, designed for switching power supplies, eliminates the need for a manual switch or user connections or optional wiring. It makes electronic equipment compatible with the most common line voltages found in different countries.

Motorola provides an applications note (AN1314/D) for its universal voltage monitor IC (MC34161), to show how to achieve such a circuit.

The output voltage is kept in an acceptable range for the switching power

Single supply difference amp

Traditionally designed using several discrete opamps and a handful of resistors, difference or instrumentation amplifiers are widely used in industrial process control, temperature and pressure transducer interfaces, and 4-20mA current loops.



Now Analog Devices has designed a monolithic, single-supply difference amplifier, the AD626, that offers superior performance, smaller size and lower cost than discrete difference amplifier designs.

The AD626 is a true single-supply difference amplifier that operates from +2.4 to +12V single or +/-1.2 to +/-6V dual supplies. Output swings are from -Vs to within 300mV of the positive rail; the common mode voltage range (CMVR) exceeds the power supply range at 0 to +24V for a +5V supply and +/-24V for a +/-5V supply.

Common mode rejection is typically 90dB, enabling the measurement of small signals riding on large common mode signals, despite power supply constraints.

Packaged in a space-saving 8-pin SOIC and mini-DIP, the AD626 has a quiescent current of only 230uA from +5V, and is thus well-suited to battery operated/power sensitive applications.

For further information circle 272 on the reader service coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

supply by sensing the amplitude of the input voltage, and adjusting the output voltage automatically. In this way, the circuit can operate over a wide AC line voltage range from 90 to 276V RMS and 50 or 60Hz, with nominal voltages of 115 and 220V AC RMS.

The IC senses whether the input voltage is greater, or less, than 160W. If the voltage is in the 160-276V range, four rectifier diodes are configured as a full wave rectifier bridge, and two output line filter capacitors (connecting in series) are each charged at every half cycle to half the line voltage. If the comparator senses a voltage in the 90-160V range, then a triac is switched on (after a delay of a few hundred milliseconds, to avoid voltage doubling during short distortions of the line voltage). This switch connects the junction of two of the rectifier diodes to the centre point of the filter capacitors, causing each to be now charged to the full line voltage. Hence, voltage doubling occurs for low line voltages, which boosts the input voltage for the switching power supply, to keep it within an acceptable range.

For further information circle 278 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 887 0711.

New 'front end' chips

Siemens has added a number of new chips to its product range for the front end of mobile radio equipment satellite receiving systems, wideband antenna amplifiers, TV receivers and tuners for car radios.

These devices include the CLY 10, a GaAs field-effect power transistor, tailored to the requirements of the new mobile radio systems. It can produce 1W of RF power at 1.8GHz, and its efficiency of more than 55% results in lighter and smaller linearity of the field effect transistor, make it ideal for wideband antenna amplifiers and satellite receiving systems.

The BAT 62 Schottky silicon detector diode provides such low capacitance (typically 0.35pF at 1MHz) that it can be used into the GHz range. It exhibits high voltage sensitivity and a minimum breakdown voltage of 40V. The double diode configuration permits temperature compensation.

Then there are two varactor diodes (BBY 51 and 52) developed by Siemens for voltage-controlled oscillators used in mobile communications. These two diodes have extremely low series resistances of 0.37 and 0.5 ohms (at 1V and 1GHz), with resulting high Q-factors, and capacitance ratios of 1.75 and 1.4.

The BBY 51 has been optimised for the 900MHz range of the GSM network, while the '52' is for the 1.5 to 2.5GHz range.

There are also pin diodes (BAR 64XX series), with low series resistance and capacitance, for voltage-controlled switches and attenuators; MOSFET tetrodes (BF1005 and 1012) for low-noise input stages, which automatically set the optimum operating point; and mixer Schottky diodes (BAT 14, 15 and 114) which cover virtually all existing oscillator powers by virtue of their different barrier heights, and are particularly suitable for downconversion from 12GHz to the first IF level (950 to 2050MHz), as well as mixer modules.

All the major RF chips from Siemens are supplied in the supermini packages, SOT 323 and SOD323, which are 1/3 shorter than the earlier '23' packages. This allows much higher packing densities on the circuit board.

For further information circle 277 on the reader service coupon or contact Siemens, Electronic Components Department, 544 Church Street, Richmond 3121; phone (03) 420 7345.

16Mb DRAMs

Toshiba has introduced a new series of 16-megabit (Mb) dynamic random access memories (DRAMs), with a 1M word x16-bit structure. Mass production is scheduled to begin in April 1993, at a monthly level of 10,000 units.

In the new series, Toshiba has adopted the advanced 0.55 micron design rule for the first time. Combined with its trench cell structure, the result is a family of memory devices that achieves a fast access time, low power consumption and small chip size: access time is as fast as 70ns, while power consumption is some 140mA.

With a chip size of 7.52 x 16.42mm, the new series is particularly advantageous for application in personal computers and low-end workstations requiring high reliability and high speed data processing. More compact computers can also be realised by using the new device to reduce the number and size of chips. Adoption of the CAS pin as byte control enables easy compatibility with 4M DRAM (1M x 4-bit word). ❖

NEW PRODUCTS

Digital audio analyser

Rohde & Schwarz has announced the Audio Analyser UPD, a versatile universal unit designed for measuring and generating diverse audio signals, both analog and digital. Due to its high measurement speed, it is also suitable for use as an automatic test system in production environments.

A large number of inputs and outputs allow adaption to practically any audio interface. The measurement functions and signals are available at all interfaces in a two channel configuration, so that all input/output combinations, (analog/analog, analog/digital, digital/digital, digital/analog) can be handled, and the results compared directly.

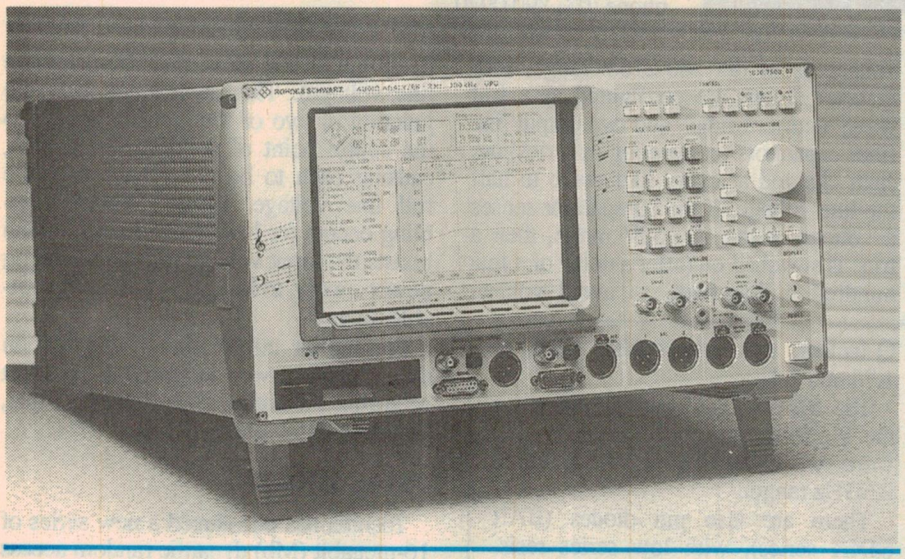
The UPD is a compact unit incorporating measurement hardware and a process controller with a 386 processor. A large number of instrument functions, for example all filters are software-based, so the audio analyser is particularly flexible. Operating and measurement software enhancements can be easily loaded via a built-in floppy disk drive. Free slots are provided to take up hardware extensions.

In spire of its large number of test and generator functions, the UPD is easy to operate, thanks to its use of a 'windowing' user interface. Every entry field automatically states the range of the parameters to be entered, and there is an exhaustive help system for each menu item.

The UPD also offers various ways of documenting the measurement: results, sweep lists and instruct settings can be stored on the integral hard disk or on a floppy disk.

Its screen display can be stored as a PCX or HPGL file, which can subsequently be processed with the aid of standard software. The screen contents can be output on a plotter or printer. Driver software is supplied as standard for the 200 most common printers.

For further information circle 242 on the reader service coupon or contact Rohde & Schwarz Australia, 63 Parramatta Road, Silverwater 2141; phone (02) 748 0155, fax 748 1836.



Fish finder

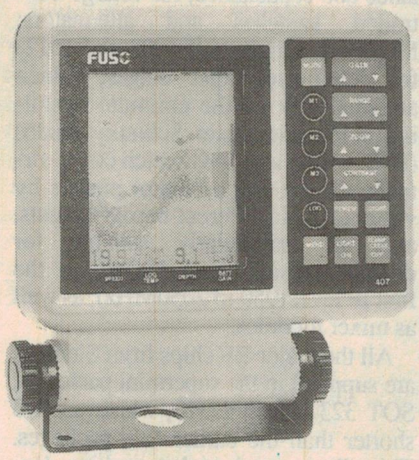
The GME-Fuso MF407 is a very easy to use sonar fishfinder. It features a backlit supertwist liquid crystal display, 120kHz frequency for genuine deep-water performance, auto or manual operation, alarms, speed, battery voltage and temperature displays.

There are four display modes, providing zoom, bottom lock, big number and instant echo; plus an NMEA interface to display GPS position, speed and heading information.

All features are accessed through a simple 'on screen' menu; once the desired operational parameters have been selected, they are retained in the MF407's extensive memory.

Advanced functions include three pages of non-volatile memory, allowing the angler to store recall and review bottom images.

The MF407 is available in through-hull, transom mount or dual beam configurations. For further information circle 241 on the reader service coupon or contact GME Electrophone, PO Box 296, Gladesville 2111; phone (02) 816 4755, fax 816 2198.



Oxide-free solder creams

Specially developed in Japan for high reliability surface mount circuits, NS (Nikon Superior) oxide-free solder creams are homogeneous stable mixtures of non-oxidised solder particles and specially prepared flux.

No mixing or thinning is required. These non-oxidised solder particles will melt and flow as quickly and cleanly as resin-cored solder wire producing no solder balling.

The solder cerams become viscous when spread, and remain tacky, thus acting as a temporary adhesive, holding components in position before and during the solder reflow.

NS oxide-free solder creams are available in a wide range of combinations of solder alloy, shapes and sizes of particles, flux percentages and viscosities.

For further information circle 243 on the reader service coupon or contact Royston Electronics, PO Box 328, Mount Waverley 3149; phone (03) 543 5122, fax 544 4894.

1GHz digital oscilloscopes

LeCroy has released its models 9320/9324 — a new family of 1GHz digital storage oscilloscopes and FET probes, with superior repetitive waveform measurement and data processing capabilities.

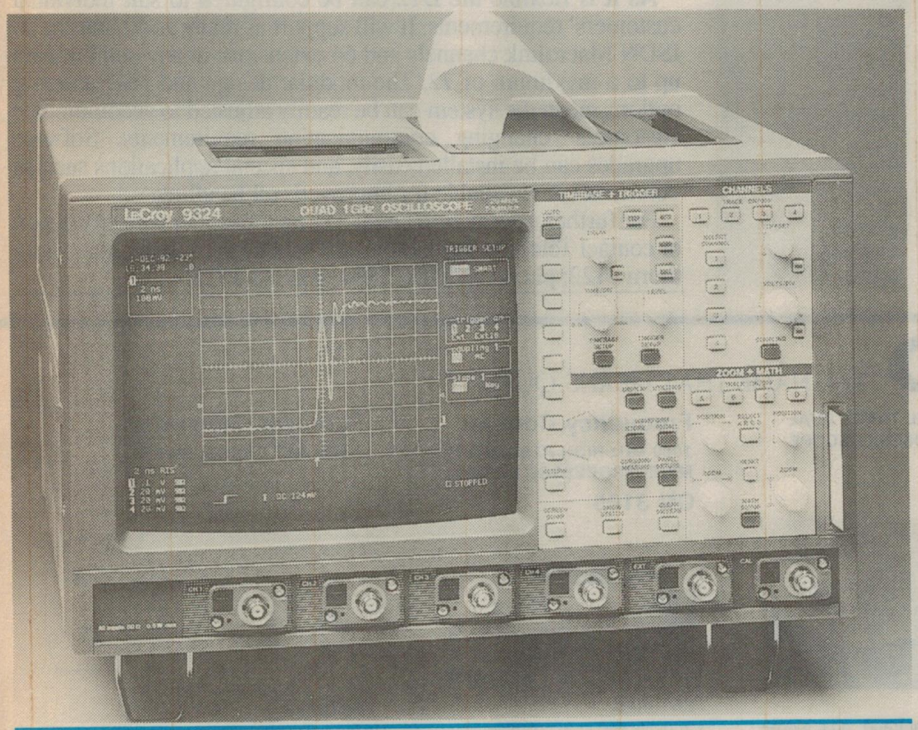
Debugging today's high speed, mixed signal electronics requires more than the 300 to 400MHz bandwidth of most laboratory oscilloscopes. 'Fast phenomena' can escape their detection, and they fail to capture glitches, bus reflections, metastable states, race conditions, and more. The 1GHz bandwidth overcomes these measurement limitations. The 9320/9324 family also offers a DOS-compatible floppy disk and memory card. These allow the transferral of waveforms from scope to scope, and from scope to computer.

Models 9320/9324, two and four channel configurations respectively, feature 5k memory per channel, 8-bit flash converters, and power 'smart' trigger modes, including glitch and pattern triggers (for triggering glitches down to 1ns and logic patterns). These are essential for sophisticated logic signal testing.

In addition to the main timebase, the 9320/9324 family provides two delayed timebases for high resolution time measurements. The crisp raster display shows from one to four independent waveform grids, and persistence and X-Y display modes.

Automatic pass/fail testing is standard. Waveform processing options include FFT, enhanced resolution, waveform zoom, math and averaging.

For further information circle 256 on the reader service coupon or contact Scientific Devices Autralia, 2 Jacks Road, South Oakleigh 3167; phone (03) 579 3622, fax 579 0971.



Extraction/insertion tool

OK Industries has released the PGA-X extraction and insertion tool, which will easily adjust to all types of pin grid array devices from 12 x 12 to 26 x 26 pins.

Adjustable thumb screws position the tool around the device to be removed. Colour coded sideplates (black for extraction and blue for insertion) assist with the correction operation. Puller finders are positioned under the PGA socket.

For further information circle 246 on the reader service coupon or contact Electronic Development Sales, 11-13 Orion Road, Lane Cove 2066; phone (02) 412 6999, fax 418 6550.

DC to AC power inverters

A range of DC to AC power inverters from Statpower Technologies is now available from BP Solar Australia. The inverters make the purchase of 12 volt appliances unnecessary, since you can use the Statpower inverter and have the freedom of a power point anywhere you choose, to run your normal day to day household appliances.

The smaller power models can be plugged directly into the cigarette lighter in a car and can be operated either with the vehicle running or with the engine switched off. A choice of four models, available in either 12V or 24V (125W to

NEW PRODUCTS

1500W continuous) allows running anything as small as a VCR/TV, up to a washing machine. Versatile and compact, the Statpower inverter can be installed virtually anywhere, and features automatic low battery and overload protection, audible and visual alarms.

For further information circle 250 on the reader service coupon or contact BP Solar Australia, 100 Old Pittwater Road, Brookvale 2100; phone (03) 938 5111, fax 939 1548.

New Commander for small business

Telecom Australia has released its latest telephone system, the Commander D72 to provide small businesses with cost effective access to new generation network technologies.

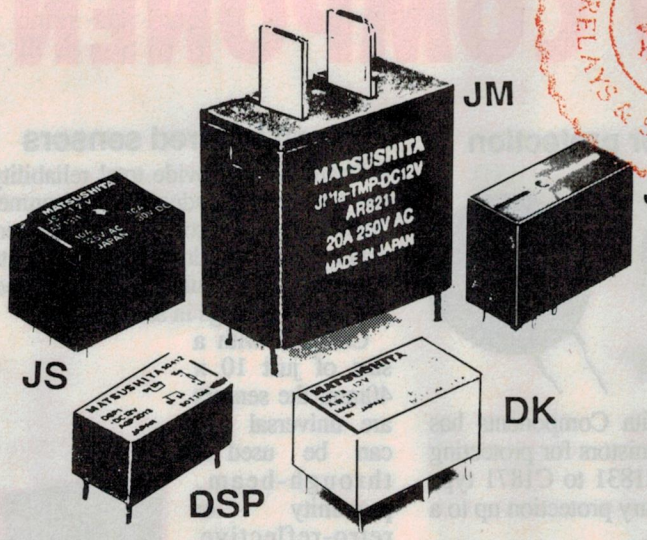
The Commander D72 has the same flexible architecture as the top of the range Commander D128 system which was launched earlier last year. It also uses the same digital key stations, providing an economic upgrade path between systems. The Commander D is currently the only key telephone system available in Australia with full Integrated Services Digital Network (ISDN) capabilities.

As it is flexible the D72 can be configured to suit individual customers' requirements. It will support as many as 40 lines or 30 ISDN Macrolink channels and 64 extensions in any combination up to a maximum of 72. The modular design and programming options mean the system can be readily adjusted to accommodate customers' changing communication requirements. Sofware upgrades can be installed easily, and special applications such as voice mail are available for improved call handling.

For further information circel 252 on the reader service coupon or contact Telecom Technologies, The Atrium, Luton Lane, Hawthorn 3122; phone (03) 818 3888, fax 818 3731.

National DESIGNER Relays

Tailored for Power Switching



JM 20 Amp 250VAC
5KV Isolation

JS *10 Amp 250VAC
Economical 1c/o

JW *10 Amp 250VAC (1c/o)
5 Amp 250VAC (2c/o)
5KV Isolation

DSP *DIL 8 Amp 250VAC 3KV Isolation

DK *10 Amp 250VAC 4KV Isolation

*Industry Standard Pinout

R.V.B. 25 YEARS NATIONAL RELAYS & SWITCHES

RVB

Distributors
RVB PRODUCTS PTY. LTD.
23 Dehavilland Rd, Braeside. Vic 3195
Tel: (03) 580 0688 **Fax:** (03) 587 3532
6/220 Pacific Highway, Crows Nest 2065
Tel: (02) 957 6385 **Fax:** (02) 929 5334

READER INFO NO. 19

Near new, at Low, Low Prices!

SIGNAL SOURCES

HP 606A 50KHz★65MHz R.F.	$375
Wavetek 2001 Sweep 1400MHz RF	$1,600
HP 8002A Pulse 10 MHz Var Rise/Fall	$210
HP 8003A Pulse 10 MHz x 2	$260
HP 8005A Pulse 20 MHz x 2	$440
HP 8005B Pulse 20 MHz x 2	$475
HP 8010A Pulse 10 MHz x 2 Var Rise/Fall	$750
HP 8015A Pulse 50 MHz x 2	$1,100
HP 211B Square Wave 10 MHz	$290
HP 204C Low Dist. Sine Wave 1 MHz	$215
HP 3300A Sine/Square/Triangle + OPTIONS	$260
BWD 141 Sine/Square 250 KHz	$160
Wavetek 131A Function Generator	$375
EXACT 337 Digital (Phase) Function	$600
SIEMENS 10–400 MHz R.F.	$140

AUDIO GEAR

G.R. 1390B White Noise Generator	$350
G.R. Audio Microvoltmeter (RARE)	$95
HEATH IMD Analyser	$160
SCHLUMBERGER IMD Analyser	$375
HP 350D 110dB Audio Attenuator	$80
HP 3590A + 3594A Selective Voltmeter + Sweeper to 620KHz	$450
HP 3591A + 3594A As Above but reads dBM/ABS/REL	$525
AMPEX Stereo (Valve) Tape PreAmp 60's	$120

HEWLETT PACKARD 5326B Frequency Counter

FEATURES
- ★3 x 50 MHz Inputs (1 at 50 ohms)
- ★Time Interval Averaging
- ★Input Level Measurement
- ★Variable Sample Rate
- ★Period Measurement
- ★1000V DVM
- ★And More

only $265

GENERAL

HP 5004A Signature Analyser	$160
HP 721A DC PSU VAR 30V @ .25A	$75
HP 738BR AC/DC Meter Calibrator	$275
HP 6920B Meter Calibrator	$245
HP 340B Noise Figure Meter	$100
HP 342A Noise Figure Meter	$250
RACAL DANA 205 Logic State Analyser with Pods Screen + Menu Drive	
(1) 16 Bit AQ + 8 Bit Gen	$1,200
(2) 24 Bit AQ	$1,500
Genral Microwave 460B Thermoelectric R.F. Power Meter	$350
BWD 602 Combo (Oscillator/Amp/PSU)	$375
Trimax Ionisation tester	$85
HP 3440A DVM 4.5 digit	$120
Gould 2200 Strip Recorder 2 pen	$260
General Radio 1650A LCR Meter	$325
IFR 1000A Coms Analyser	$9,500

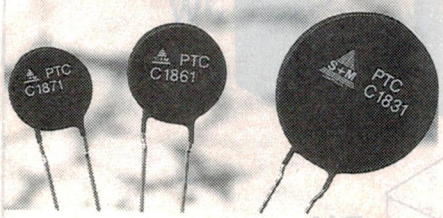
BARGAIN CORNER

STC 74600A Attenuator 1–99dB 50Ω DC–100MHz	$60
HP 580A Digital to Analogue	$40
HP 7221T A3 8 pen Plotter	$150
TEK RM/561 Oscilloscope Dual Trace 500KHz	$175
Alfred 650 Sweeper 1.7–4.2 GHz	$120
HP 431B Microwave Power (Meter only)	$50
HP 8690A RF Sweep 1–2/12.4–18GHz Modules	$425

Special Feature:

NEW COMPONENTS

Thermistors for protection

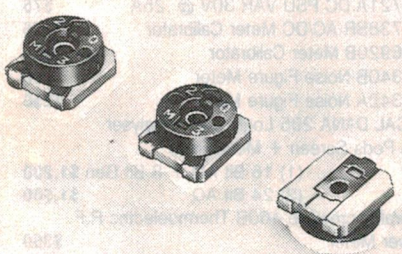


Siemens Matsushita Components has developed new thermistors for protecting transformers. The C1831 to C1871 type series provides primary protection up to a rated load of 100VA.

The thermistors are designed for a maximum operating voltage of 265V. Depending on their design, they are suitable for a rated current of 120 to 470mA, and for switched currents of 250 to 990mA. The diameter of the thermistor discs varies between 9 and 22mm. The new range provides shortcircuit protectors for transformers of the type used in halogen lamps, for instance.

For further information circle 202 on the reader service coupon or contact Siemens Electronic Components, 544 Church Street, Richmond 3121; phone (03) 420 7716.

Sealed SMD trimpot



Murata Manufacturing has released the RVG4M series of extremely thin and subminiature (4.7 x 4.0 x 2.0mm) and lightweight (78mg) SMD trimmer potentiometers. The RVG4M is suitable for both flow and reflow soldering, and is sealed to withstand the immersion cleaning process.

Rated at 200V DC maximum, it is available in resistance values of 100 to 2M. At 1/4W @ 70°C, the RVGM58 has a maximum resistance change of +/-5% over 100 cycle rotations, and a TC of +/-100ppm/°C (200 to 50k) and +/-150ppm/°C (100k+).

For further information circle 204 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766.

Rugged infrared sensors

Designed to provide total reliability in the toughest of industrial environments, Telco infrared sensors are not bothered by water, steam, dust, dirt, vibration, temperature or sunlight, and can lead to substantial savings in service costs.

Compact with a size of just 10 x 40mm, the sensors are universal and can be used in through-beam, proximity or retro-reflective modes, operating up to a distance of 35m when used with a PA amplifier. A separate transmitter and receiver design allows complete flexibility in mounting the sensors.

The sensors can be used in car washes, wood machinery, automatic doors and practically all areas of control and monitoring — from mining raw materials, to handling, packaging and distributing finished products.

For further information circle 201 on the reader service coupon or contact Micromax, PO Box 1238, Wollongong 2500; phone (042) 26 6777.

E24 chip resistors

A full range of Kyocera chip resistors in E24 values, at 1% and 5% tolerance, is now available. These resistors use high quality thick film material, with good noise characteristics. The resistance is adjusted with high reliability laser trimmer systems.

Terminations are composed of nickel plated silver electrodes, with a special solder plating to give good solderability, solder heat resistance and adhesion strength. The resistors are available in the following packages: 1206, 0805, 0603 and 0402.

For further information circle 203 on the reader service coupon or contact ACD, PO Box 139, Bayswater 3153; phone (03) 762 7644.

Audio indicators

Crusader Electronic Components has released an extensive range of Ohmite piezo audio indicators and piezo ceramic audio transducers. The piezo audio indicators can be supplied as panel/flange or PC board mount types, and are available in three different tones and combinations.

The piezo ceramic audio transducers are either of the external drive type or self drive type, using a recommended self driven circuit which uses transistor switching.

For further information circle 206 on the reader service coupon or contact Crusader Electronics, 73-81 Princes Highway, St Peters 2044; phone (02) 516 3855, fax 517 1189.

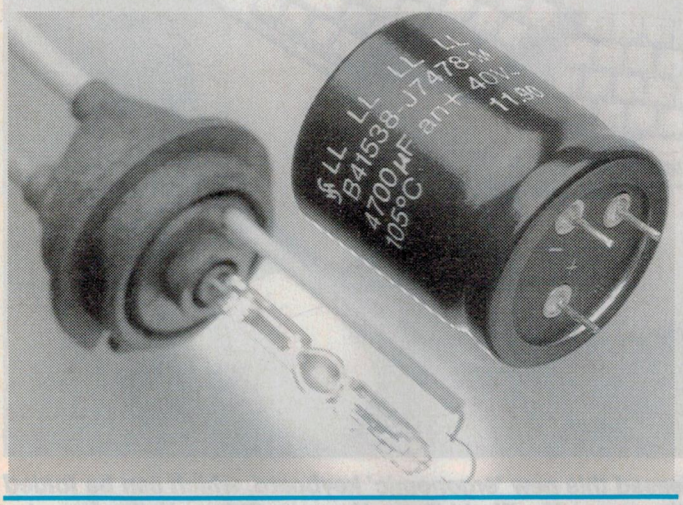
High temp electrolytics

Siemens now has available a range of aluminium electrolytic capacitors, designed to withstand high ambient temperatures of up to 105°C.

Automotive electronics require extreme miniaturisation and high performance at the same time. Both demands are met by the B41538 range. The aluminium electrolytic capacitor is characterised by a long lifespan — it ensures that airbag or xenon vapour pressure lamp systems in motor cars never fail. These high capacitance capacitors are also used in communications and data systems.

The package size of the electrolytic capacitor range varies between 18 x 30mm and 25 x 40mm

For further information circle 209 on the reader service coupon or contact Siemens Electronic Components, 544 Church Street, Richmond 3121; phone (03) 420 7716.



Washable trimmer capacitors

The AVX/Kyocera product line now includes a new 'washable' type CTZ surface mount trimmer capacitor.

This component uses a resin sealing compound around the trimming pin mechanism, to allow for washing with freon solvents. The CTZ range is an open-frame construction, with a considerable advantage is size reduction.

Its features include ultra small size, exclusive use by reflow soldering, and high capacitance.

For further information circle 210 on the reader service coupon or contact ACD, PO Box 139, Bayswater 3153; phone (03) 763 7644. ❖

Silicon Valley NEWSLETTER

Inventor says Apple copied his keyboard

At the recent MacWorld Expo, Apple Computer launched an innovative new ergonomic keyboard that can be folded out into a 'V' shape. But a lone Silicon Valley inventor cried foul, claiming Apple had stolen his idea.

Tony Hodges of Mountain View said he will sue Apple, after learning about the launch of Apple's ergonomic keyboard. Hodges has been trying to sell his design for such an ergonomic keyboard since 1986. In fact, Hodges said he has made presentations to as many as 140 Apple officials over the years, including Apple chief John Sculley.

Hodges said the US$219 Apple keyboard is 'a deliberately crippled' version of his so-called 'Tony' — a keyboard that not only folds out into a 'V' shape, like the Apple keyboard does, but also tilts upward from the centre for maximum user comfort. Still, the Apple keyboard looks very much like the Tony. Among other things, Apple's board breaks off along the same line of letters (to the right of the '5-T-G-B' keys).

"What Apple has done is infamous. I am going after them for criminal theft of my property," Hodges said. "They think they can get away by only stealing part of it (his design). They think they can walk all over a little guy like me."

At MacWorld, Apple emphasised it has become the first major computer vendor to offer customers the ergonomic keyboard. However, it could not prevent the controversy from taking away the bloom of its public relations effort to promote the keyboard.

Patent attorneys agreed Hodges, who has a patent on the design of his keyboard, may have a strong case based on the obvious similarity of the designs. The patent describes the Tony as a keyboard which can be rotated in many ways, including flat on the desk like the Apple keyboard, as well as up in the air. In the later position, the Tony's individual keys adjust for the angle of tilt.

Hodges said he first showed his US$625 keyboard to Apple in 1987. He offered Apple to licence his design. Apple, he said, was interested, but backed out of a deal because it could not accept Hodges' demand that the keyboard be produced by a US company. That would have upset Apple's relationship with its Japanese keyboard suppliers.

Apple Computer released this new 'ergonomic' keyboard, which can be folded into a 'V' shape, at the recent MacWorld Expo. However Silicon Valley inventor Tony Hodges claims that the keyboard is a cheapened copy of his 'Tony' keyboard, which he invented in 1986 and has patented. (See story at left).

Mini battery firm gets mail order

Valence, a tiny San Jose start-up that is developing a new longer-life rechargeable battery, announced it has received a US$100m order to develop and build batteries for Motorola's line of cellular phones, pagers, and other communications devices.

Valence is developing a solid lithium-polymer battery that is both smaller, lighter, stronger, and cheaper to produce than current nickel-cadmium batteries.

The contract with Motorola called for Valence to start shipping prototype batteries in the first quarter of 1993, with volume deliveries starting in early 1994. The contract will accommodate about half of Motorola's expected battery purchases during the 1994-1996 time frame.

Under the terms of the agreement, Motorola will have a two year worldwide exclusive purchase and resale right for the Valence batteries when used for certain communications related applications.

Industry analysts said that beside propelling Valence to a major battery supplier, Motorola will have a significant competitive edge during the next two years as the batteries will allow the firm to significantly reduce the weight of many of its consumer products.

Micron wants ban on Korean DRAMs

After celebrating a major victory against its Korean competitors, Idaho-based Micron Technology has asked the Federal Trade Commission to ban the import of Hyundai and Goldstar-made DRAM memory chips, which it claims incorporate Micron-owned chip etching technology which the firms are using without proper licence. Earlier the US Commerce Department ruled that all three major Korean DRAM makers have been dumping their chips in the US and slapped heavy anti-dumping duties on their products.

S-A to make Iridium terminals

Scientific-Atlanta Inc and Motorola have entered an agreement contract aimed at producing earth terminals for the Iridium global communications program. Both companies will work together to develop specifications for earth terminals to be used in Iridium terrestrial satellite communications gateways.

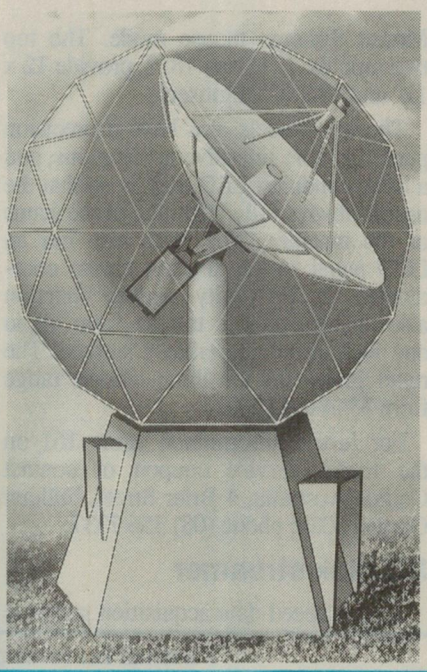
Once operational, Iridium is planned to provide a worldwide digital, satellite-based, cellular personal communications system. Users will be able to transmit and receive digitised voice, data and facsimile signals via handheld, mobile or transportable units, anywhere on earth.

The system includes a constellation of small, smart satellites in low-earth orbit, networked together as a switched digital communications system. Iridium satellites will provide continuous line-of-sight coverage from and to any point on the earth's surface, as well as all points within an altitude of about 16km.

The low-earth orbit of approximately 780km is designed to reduce significantly the phenomenon of voice delay. The system program is an extension of three existing technology areas: cellular communications; satellite systems; and communications networking and switching.

Scientific-Atlanta will develop and manufacture four preproduction earth terminal units beginning in early 1993.

Full scale high volume production is scheduled to begin in 1994. The first satellites are planned for launch in 1996, with the constellation complete and operational by 1998.



Now Micron said it wants all DRAMs from Goldstar and Hyundai stopped at the US border. "The remedy we seek is to have all imports of violating products banned from the US market," said Micron vice president Reig Langrill.

Industry observers were divided on the question of the merit of the Micro case and its objectives.

Micron has not made it clear whether it wants to ban the chips, or use the threat of such action as a means to obtain licence and royalty payments from the two Korean firms.

Intel gets US$380M from Israel

Intel has confirmed reports that the Israeli government has approved US$380 million in grants to help Intel expand its Jerusalem chip production facilities.

Intel spokesman Howard Hines said that the company has not yet approved the expansion plans for the Jerusalem facilities. A major factor in that decision is how new European Common Market 'local content' rules will affect Israel's status with the EEC.

Until now, Israel has enjoyed a tariff-free import status, allowing Intel to supply much of its European customer base with microprocessors and other chips from the Jerusalem plant without having to pay any EEC chip duties.

To circumvent the local content duties, Intel, along with most other major semiconductor houses are building or expanding their European facilities. That would leave Intel with little or no reason to expand, or even keep the Jerusalem facility.

Hines confirmed that if Intel does go ahead with the Israeli expansion, the plant's output would be used to supply customers worldwide rather than those in Europe. He also said that the level of the Israeli grant is tied to the level at which Intel will expand the Jerusalem facility.

Asked whether the grant appears very large by most government incentive standards, Hines said the government of Israel believes the program represents a good investment in ensuring a continued large microprocessor production activity within the country, as well as in regard to the creation of many new jobs.

Cypress moving assembly offshore

Cypress Semiconductor chief T.J. Rodgers, who for years has repeatedly blasted larger competitors for moving their production overseas, has announced his firm is moving wafer fab operations to Minnesota and Texas, and moving all of its remaining assembly operation manufacturing operations to Thailand.

In the second restructuring program in less than six months, Cypress said it could no longer afford to manufacture in San Jose.

It is moving wafer fab operations to an under-used facility in Minnesota, which is capable of producing both Cypress' lines of microprocessors and SRAM memory chips.

Other product lines will be moved to Cypress' Texas-based facilities. The San Jose production facilities will be converted to research-oriented production facilities. The moves will cause more than 400 people to lose their jobs.

Rodgers, who has complained for more than 10 years about the high cost of doing business in Silicon Valley, said the decision to move out of Silicon Valley was difficult. "When you build an organisation over a decade, to tear it apart is a very sad thing. One of the reasons we have ended up losing money is that it took me a long time to bite the bullet. I fought it every way that I could."

The restructuring moves will cost Cypress US$97.2 million.

Big grey market bust

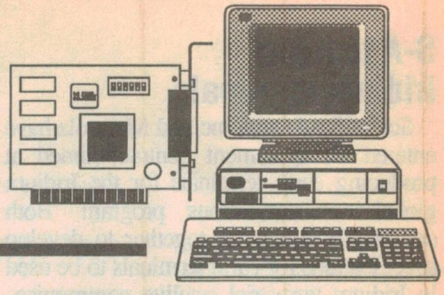
Silicon Valley authorities have announced the arrest of more than 30 people, following a series of undercover sting operations aimed at grey market dealers who sell stolen semiconductors, parts and computer equipment.

During the operation, police met with grey-market dealers in motel rooms selling millions of dollars worth of supposedly stolen Intel and AMD microprocessors, disk drives and other items, often offering the items for a fraction of their market value. In all, the police recovered US$1.5 million in cash and US$1.8 million in stolen property from the busted dealers.

"There is a definite criminal element associated with the high-tech industry," said Detective Mark Kerby. Some of the arrested were members of notorious Los Angeles street gangs, others belonged to Hells Angels-type motor cycle clubs, and still others were part of a group of Vietnamese burglary teams.

Kerby said there is big money in stolen high-tech items, particularly microprocessors which are small and valuable, yet stolen parts are impossible to distinguish from legitimate chips. He said the members of the sting team were surprised how easy it was to catch so many grey-market dealers and suppliers. "I thought they had a better communications network. But the next group was just as eager in making a deal as the previous one we just busted." ❖

Computer News and New Products



HiSketch digitisers

Genius Australia has released a new range of high resolution digitising tablets for DOS and Windows-based PCs, which have been packaged with high-end graphics software. Called the HiSketch range, the three models come bundled with AutoSketch 2.0 and Microsoft Pen for Windows. This provides the digitiser user with a 'total solution' to assist in a variety of tasks, from creating professional drawings or precision graphics, to resizing and placing them in other applications.

The entry model 906 has a 9 x 6" digitiser, provides 0.01" accuracy, and is completely compatible with both DOS and Windows applications. It includes a three button smart stylus for freehand rendering in DTP.

The model emulates Microsoft and Mouse Systems mouse mode. The top two models, 1212 and 1812, provide 12 x 12" and 18 x 12" digitisers.

The top models also have a precision puck for more intensive applications, and a three condition LED display so that the user is always fully informed of the status of the machine. The 1812 also has an LCD panel which displays cursor coordinates. Its proximity sensing function also enables precise tracing from up to one inch above the tablet's surface. The retail prices for the three models range from $344 to $1050.

For further information circle 161 on the reader service coupon or contact Genius Australia, 4 Briar Street, Fulham Garden 5024; phone (08) 356 7337.

PC disk streamer

A high speed data acquisition software package (PCLS-801) is available for IBM AT or compatible computers. The PC streaming package is capable of streaming up to 16 channels of acquired data to disk.

The package has been developed for the PC Labcard range of multi-function DAS cards. Multi-channel streaming is supported with the PCL-718, PCL-818 and PCL-814 DAS cards, and single channel streaming is supported with the PCL-812 and PCL-812PG DAS cards.

The sampling rate is 30kHz to 100kHz, depending on the DAS card's capabilities, storing up to 200kbps to the storage media. The data acquisition can be triggered using analog level thresholds between -10V to +10V. The trigger threshold is adjustable at increments of 1LSB for 12-bit and 14-bit cards.

The PCLS-801 software package in-

Ultra-thin note book

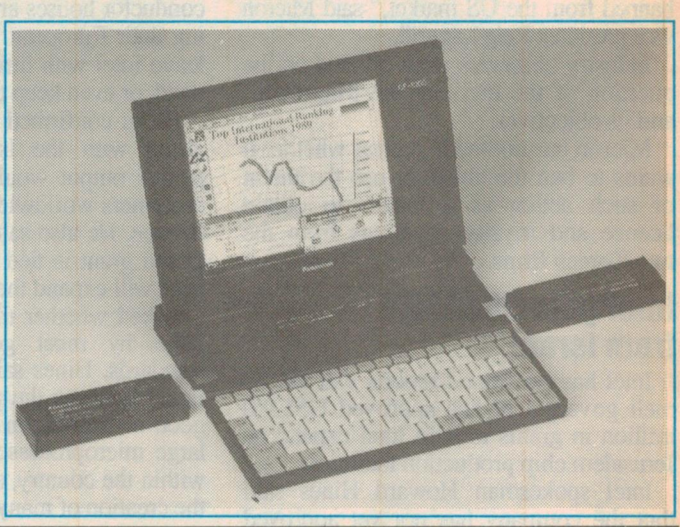
Panasonic has released an ultra-thin advanced notebook computer, the CF-1000. At 32mm, the CF-1000 is one of the slimmest notebook computers on the market, and it also has a removable floppy disc drive which allows the addition of a second battery. This, along with its power-saving 3.3V circuitry, offers up to 11 hours continuous power for interactive computing.

The CF-100 hs been designed for the general business and personal markets. It has a generous 9.5" (24cm) LCD screen, yet weighs only 2.3kg and is a mere 32mm thick, so it can be comfortably carried in a briefcase with plenty of room to spare.

SuperStor disk compression software bundled with the CF-1000 packs up to 110MB into the 60MB drive, with disk access to any track in an average of just 19ms. The CF-1000's optional docking unit provides instant, plug-in access to peripheral devices at the home or office. Its bus extender holds two 16-bit cards — including one full length card and one short card — for specialised purposes, such as a network interface.

The CF-1000 also has complete interface facilities with connectors provided for an external keyboard or mouse, colour VGA monitor, external modem and printer. The serial modem port even includes a buffered UART to prevent dropped characters during high speed file transfers. The optional CF-AM2400 internal fax modem gives the user a 2400bps data transmission capability, with graphics output at 200dpi.

Panasonics CF-1000 comes pre-installed with MS-DOS 5.0, Windows 3.X and SuperStor Disk Compression Utility Version 2.0. Its recommended retail price is $3599, while the optional internal fax modem retails for $699.



cludes a file conversion utility which converts the acquired raw binary data to ASCII file format. Up to four channels can be replayed using the preview facility of the PCLS-801. PC-Streamer package or the data can be further analysed and displayed using the DADISP software package. The PCLS-801 is ideal for waveform recording, transient analysis, vibration analysis and audio digitising applications.

For further information circle 162 on the reader service coupon or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521 0266.

Portable programmer

The Sunshine Jet-01 EPROM programmer is a high speed portable programmer able to operate without external power supply for one hour maximum. It is capable of programming EPROMs from 2764 to 27080 (5Mb), as well as 8751 series microprocessors. It has a high burn-in speed of four seconds for a 27256 EPROM, with support functions such as check, verify and auto.

With a rechargeable battery embedded, the unit is very suitable for field use. Sunshine also produces simple EPROM programmers, high speed programmers, high speed multi-gang units, RAM/ROM emulators and universal device programmers.

For further information circle 163 on the reader service or contact Baltec Systems, 26 Mayneview Street, Milton 4064; phone (07) 369 5900.

Four serial ports for Windows

The WINCOMM4 four-port serial card from Industrial Computer Source provides four RS-232 serial ports allowing printers, modems, plotters, terminal, etc., to be connected to an IBM PC.

Individual address switches are provided for each serial port, allowing them to be configured as COM1 through COM4, or any other I/O address up to 3FF Hex. Each port has individual interrupt selection and supports IRQ2-7, 10, 11, 12 or 15. Multiple cards can be installed in a system and interrupts can be shared between boards to overcome the conflicts that can occur in systems supporting many I/O devices. All ports support full modem controls.

The individual address and interrupt selection of the WINCOMM4 make the board ideal for systems running the Windows 3.1 operating environment. WINCOMM4 will provide the hardware

support without the use of additional software drivers that Windows 3.1 requires to make use of four serial ports.

For further information circle 166 on the reader service coupon or contact Interworld Electronics & Computer Industries, 1000 Glenhuntly Road, Caulfield South 3162; phone (03) 563 5011.

Approved PCMCIA 2.0 mini modem

NetComm has announced the first Austel approved modem conforming to the PCMCIA 2.0 (Personal Computer Memory Card International Assiciation) standards for portable computing. The credit card sized NetComm CardModem 24 provides high performance and low-cost connectivity for notebooks, palmtops and handheld PC's. It allows users to connect to the telephone system by simply sliding the modem into an external slot on the PC.

The modem requires no external power and features three power management modes to maximise battery life: active, power save and power down. Compatibility with standard communication packages is achieved through the modems support of the Hayes AT Command set.

The CardModem 24 is a 2400bps (V.22bis) modem card that supports V.42, MNP2-4 error correction and MNP5 data compression, ensuring faster, more accurate data transmission. With data compression an effective throughput rate of up to 4800bps is achievable from the modem.

The modem is suitable for all major brands of handheld notebooks, palmtops and PCs that support the PCMCIA 2.0 standard.

It features automatic line speed detection and adjustment for standard national and international speeds including CCITT V.22bis, V.22, V.21, Bell103 and 212A. It measures 85 x 55 x 5mm and includes an Austel approved detachable line adaptor to connect to the telephone system. AutoSoft Communications Software is incorporated.

The CardModem 24 retails for $799, including tax. For further information circle 167 on the reader service coupon or contact Netcomm, 25 Paul Street North, North Ryde 2113; phone (02) 888 5533.❖

DSE introduces 'Computer Easy'

Dick Smith Electronics has launched an innovative and comprehensive computer purchase and after-sales service plan called 'Computer Easy', designed to remove the risk and hassle out of buying a computer system. The initiative is being supported by leading suppliers of hardware and software, including IBM, Commodore, DSX, Epson, Citizen, Star, Oki, Avtek, Microsoft and Lotus.

Key elements of the plan include free system installation in the home or office, free 12-month on-site warranty service and free introductory training (three hours) — all providing the customer site is within 50km of a company-owned store. For more remote customer sites, a small charge will be made for technician travelling time. Also included will be free computer hotline support anywhere in Australia, free access to the DSE bulletin board with its public-domain software and shareware, and free membership of the DSE 'VIP Club' with a regular newsletter and special offers on peripherals, etc. New members of the VIP Club are currently being offered a modem and software at a special discount price.

In launching the new plan, DSE managing director Jeffrey Grover noted that purchasing a computer can be time consuming, expensive and confusing. "We believe that in Computer Easy, we have the answer to this and other problems confronting the computer purchaser."

Further information on Computer Easy is available at any Dick Smith Electronics store, or by calling (008) 22 6610 from anywhere in Australia. Sydney callers can also use 888 2105.

Tiny fax/data modem

An Australian made fax/data modem, with Austel approval, is only 25% longer than a credit card and only 2.2cm thick. It comes supplied with 'Mirror' full features data and fax software, and operates from any MS DOS computer. And it costs under $200.

Some of its features are: Hayes-compatible auto answer and dial (pulse or tone); non-volatile RAM for configuration and phone storage; file transfer support for KERMIT, XMODEM, YMODEM and ZMODEM; and faxes can be sent and received transparently in the background.

Data is transmitted as V22 bis at 2400bps MNP 1-5 and V42/V42 bis is included in software to give automatic error correction and effective transfer rates up to 9600bps, depending on data type. Conventional group III fax at 9600bps send, and 4800bps receive, allows transmission and reception of text, documents and images to any fax machine or computer equipped with a fax/modem. Computer-generated faxes are received with much greater clarity than scanned images from normal fax machines. Fax files can be converted to .CUT or .PCX format, so a remote fax machine can be used as a 200dpi scanner to import images into DOS applications. Printout is to Epson or HP LaserJet printers, or compatibles.

For further information circle 168 on the reader service coupon or contact DGE Systems, PO Box 111, Hamilton 2303; phone (049) 69 1625.

Hakko 926 Soldering Station

The Hakko 926 is a super-quick heat-up (3 sec cycle) and fast recovery iron offering high quality soldering at lower tip temperatures. The built-in ceramic heater maintains temperature to within 0.5°C of the setting. Yes this is an ADJUSTABLE temperature iron covering the range from 200°C to 480°C using a full wave zero-crossing switching system. Meets MIL-STD-2000 and operates at safe 24V.

Also available in ESD for antistatic environments. We stock a wide range of tips to suit. Ask for listing.
$183.95

We stock the Hakko Iron Range PLUS Spare Parts

HKO-802-ELEMENT	802 24V/50W Heater Elmt	62.20
HKO-802-FLTR-SPR	802 Spring Filter	18.90
HKO-802-NZL-0.8S	802 0.8mm Slim Nozzle	27.30
HKO-802-NZL-1.0S	802 1.0mm Slim Nozzle	27.30
HKO-802-NZL-0.8	802 0.8mm Nozzle	27.30
HKO-802-NZL-1.0	802 1.0mm Nozzle	27.30
HKO-802-NZL-1.3	802 1.3mm Nozzle	27.30
HKO-802-NZL-1.6	802 1.6mm Nozzle	27.30
HKO-802-PIPE-HLD	802 Filter Pipe Holder	24.25
HKO-PAPER-FLT-LG	Large Crmc Ppr 802/483	12.60
HKO-802-PAPER-S	802 Small Ceramic Paper	12.60
HKO-PIN-0.8	0.8mm Clng Pin 802/483	3.60
HKO-PIN-1.0	1.0mm Clng Pin 802/483	3.55
HKO-PIN-1.3	1.3mm Clng Pin 802/483	3.55
HKO-PIN-1.6	1.6mm Clng Pin 802/483	3.55
HKO-O-RING	O-Ring for 802/483	3.10
HKO-481-HEATER	481 Heater	34.45
HKO-481-TOOL	481 Tip Removal Tool	18.90
HKO-483-HEATER	483 Heater Element	31.15
HKO-483-T-0.8	483 0.8mm Tip	33.90
HKO-483-T-0.8S	483 0.8mm Slim Tip	33.90
HKO-483-T-1.0	483 1.0mm Tip	33.90
HKO-483-T-1.0S	483 1.0mm Slim Tip	33.90
HKO-483-T-1.3	483 1.3mm Tip	33.90
HKO-483-T-1.3S	483 1.3mm Slim Tip	33.90
HKO-483-T-1.6	483 1.6mm Tip	33.90
HKO-483-CORE	483 Heater Core & Cover	57.85
HKO-483-PIN	483 Heater Core Pin	6.50
HKO-483-TOOL	483 Tip Removal Tool	15.60
HKO-483-FILT-SET	483 Filter Set & Pipe	11.60
HKO-483-DIAPHRAM	483 Diaphram Set	32.60
HKO-483-FILTERS	483 Filter Set 10 Piece	19.00
HKO-TIP-DS-0.8	Tip for 483/707/700	31.75
HKO-TIP-DS-1.0	Tip for 483/707/700	31.75
HKO-800L-HEATER	60W Heater for 700C	35.25
HKO-800L-CORE	800L Heater Core	66.45
HKO-850-HEATER	850 Heater Element	58.10
HKO-850-HTR-PIPE	850 Heater Element Pipe	49.90
HKO-TIP-M-1.6D	1.6mm Dual Flat Tip	9.70
HKO-TIP-M-1.8H	1.8mm Offset Tip	16.40
HKO-TIP-M-1C	1.0mm Conical/Tip	9.70
HKO-TIP-M-1CF	1.0mm Conical Flat Tip	15.10
HKO-TIP-M-2.4D	2.4mm Dual Flat Tip	9.70
HKO-TIP-M-2C	2.0mm Conical Tip	9.70
HKO-TIP-M-2CF	2.0mm Conical/Flat Tip	15.10
HKO-TIP-M-3.2D	3.2mm Dual Flat Tip	9.70
HKO-TIP-M-3C	3.0mm Conical Tip	10.20
HKO-TIP-M-3CF	3.0mm Conical/Flat Tip	10.20
HKO-TIP-M-4C	4.0mm Conical Tip	10.65
HKO-TIP-M-4CF	4.0mm Conical/Flat Tip	10.20
HKO-900L	Heavy Duty Iron	61.20
HKO-900M	Iron with 1.6mm Tip	59.55
HKO-900M-HEATER	Heater for 926	29.25
HKO-926-HOLDER	Complete 926 Iron Hldr	29.35
HKO-926-SPONGE	926 Tip Sponge	3.95
HKO-ANTI-SEIZE	Anti Seize Compound	3.80
HKO-GREASE	Silicone Grease	5.40

100W DIC SC-7000 DeSoldering Tool

- Now with 100W ceramic heater
- Work on up to 12 layer boards
- Special antistatic housing
- Optional surface mount kit

$458.00 ex tax
$549.60 inc tax

Just In

Electrolube PR50 Positive Acting Photo-Resist.

Ideal for pcb's, etching pictures onto copper plates, etc. Uses new safe, acqueous alkali developing and removing chemicals.
RP50 Photo-Resist 200ml aerosol **$33.00**
RP50 Photo-Resist Developer 250ml bottle **$13.35**

We stock the full range of Electrolube products in sizes to suit all requirements. Call for detailed pricing

Analog Panel Meters

We carry a wide range of analog meters for projects, instruments etc. If you have a requirement not listed ask and we'll locate something suitable.

- *SEW meter movements*
- *Not susceptible to stray fields*
- *High precision jewel and pivot suspensions*

ST-38-100uA-DC	45x45mm Panel Meter	19.40
ST-38-50mA-DC	45x45mm Panel Meter	19.40
ST-38-1mA-DC	45x45mm Panel Meter	19.40
ST-38-10A-AC	45x45mm Panel Meter	19.40
ST-38-10A-DC	45x45mm Panel Meter	19.40
ST-38-10V-DC	45x45mm Panel Meter	19.40
ST-38-20V-DC	45x45mm Panel Meter	19.40
ST-38-30V-DC	45x45mm Panel Meter	19.40
ST-45-10A-AC	51x51mm Panel Meter	19.40
ST-45-10A-DC	51x51mm Panel Meter	19.40
ST-45-20A-AC	51x51mm Panel Meter	19.40
ST-45-20A-DC	51x51mm Panel Meter	19.40
ST-45-30A-AC	51x51mm Panel Meter	19.40
ST-45-30A-DC	51x51mm Panel Meter	19.40
ST-45-50uA-DC	51x51mm Panel Meter	19.40
ST-45-100/100uAD	51x51mm Panel Meter	19.40
ST-45-50/50uA-DC	51x51mm Panel Meter	19.40
ST-45-100mA-DC	51x51mm Panel Meter	19.40
ST-45-100uA-DC	51x51mm Panel Meter	19.40
ST-45-DCA-+/-5	51x51mm Panel Meter	19.40
ST-45-1mA-DC	51x51mm Panel Meter	19.40
ST-45-1A-DC	51x51mm Panel Meter	19.40
ST-45-5A-DC	51x51mm Panel Meter	19.40
ST-45-10V-DC	51x51mm Panel Meter	19.40
ST-45-20V-DC	51x51mm Panel Meter	19.40
ST-45-300V-AC	51x51mm Panel Meter	19.40
ST-45-30V-DC	51x51mm Panel Meter	19.40
ST-65-10A-AC	67x67mm Panel Meter	20.25
ST-65-30A-AC	67x67mm Panel Meter	20.25
ST-65-50uA-DC	67x67mm Panel Meter	20.25
ST-65-1mA-DC	67x67mm Panel Meter	20.25
ST-65-100uA DC	67x67mm Panel Meter	20.25
ST-65-100/100uAD	67x67mm Panel Meter	20.25
ST-65-1A-DC	67x67mm Panel Meter	20.25
ST-65-5A-DC	67x67mm Panel Meter	20.25
ST-65-10A-DC	67x67mm Panel Meter	20.25
ST-65-20A-DC	67x67mm Panel Meter	20.25
ST-65-30A-DC	67x67mm Panel Meter	20.25
ST-65-300V-AC	67x67mm Panel Meter	20.25
ST-65-10V-DC	67x67mm Panel Meter	20.25
ST-65-20V-DC	67x67mm Panel Meter	20.25
ST-65-30V-DC	67x67mm Panel Meter	20.25
ST-70-5A-DC	70x70mm Dual DC 30V 5A	42.95
ST-70-15A-DC	70x70mm Dual DC 30V 15A	42.95
ST-70-30A-DC	70x70mm Dual DC 30V 30A	42.95
ST-72-45-55Hz	Mains Frequency Meter	63.00
ST-96-25A-AC	Right Angle AC Pnl Mtr	21.70
ST-96-300V-AC	Right Angle AC Pnl Mtr	21.70
ST-100-5A-DC	100x80mm Panel Meter	31.25
ST-100-30V-DC	100x80mm Panel Meter	31.25
ST-160	120x94mm With Lamp	27.80
ST-670-100mA-DC	70x60mm Panel Meter	20.30
ST-670-1A-DC	70x60mm Panel Meter	20.30
ST-670-10A-AC	70x60mm Panel Meter	20.30
ST-670-10V-DC	70X60mm Panel Meter	20.30
ST-670-20V-DC	70x60mm Panel Meter	20.30
ST-670-30A-AC	70x60mm Panel Meter	20.30
ST-670-30A-DC	70x60mm Panel Meter	20.30
ST-670-30V-DC	70x60mm Panel Meter	20.30
ST-670-100uA-DC	70x60mm Panel Meter	20.30
ST-670-300V-AC	70x60mm Panel Meter	20.30


ST-38


ST-45


ST-65


ST-70

Special $19.00


ST-100


ST-160


ST-670

Call us for all those hard to get parts like
• Resistor Networks
• Metal Film Resistors
• Transformers
• MKT's plus our HUGE Semiconductor Range

Feeling Blue?

Then we have LED's to suit in 3mm and 5mm with a water clear case. 14mcd (typ) brightness at 20mA and 3.0V (typ). 5V reverse. 470nm wavelength and 30° viewing angle. Both sizes **$3.95** ea, **$3.55** 10 up, **$3.00** 100 up

Fan Price Blown Away!

25% blown off 12V 120mm fans, while stocks last ONLY $18.00

Printer Cable Specials

This month only save a third off PC printer cables.
Two lengths.
1.8m normally $14.95
Save $5.00 –
NOW ONLY $9.95
5m Normally $29.95
Save $10.00 –
NOW ONLY $19.95

"Electronic Workbench"

The Electronics Lab you keep in your PC!

YES you can now build, simulate and test Analog and Digital Circuits without using a single component!

It's so easy with Electronics Workbench®. Use mouse to drag new parts from the parts bin, drop them onto the breadboard and click to run wires. Editing circuits is easy as wires are re-routed automatically.

It's much faster than building real circuits. No faulty parts! It's the result of 10 years innovation and thousands of users of Workbench since its introduction in 1988.

Analog Module includes

- Parts bin includes op-amps, zeners, transistors etc
- Function Generator with sine, square, triangle etc
- Oscilloscope with dual trace, int/ext trigger, timebase upto 999MHz
- Bode Plotter for frequency and phase (-200 to +200dB)
- SPICE Simulation plus transient and steady-state simulation

Digital Module includes

- Parts bin with gates, flip-flops, half adders, displays etc
- Word Generator up to 16x8-bits
- Logic Analyser with 8 channels, int/ext trigger
- Logic Conversion between gate, truth table and boolean

Professional version has inhanced colour interface, supports co-processor. Requires IBM AT or PS/2 with 286 or greater, hard disk, 640kB RAM, Microsoft mouse, EGA/VGA and DOS 3.0. **$429.00**

Personal Plus version is monochrome. Requires PC/XT/AT or PS/2 , 2 floppies or hard disk, 512kB RAM, Microsoft mouse, CGA/EGA/VGA/Hercules and DOS 3.0. **$299.20**

See the review in Electronics Australia March 92

Low Cost Software for IBM

Applications	*Education*	*Entertainment*	*Utilities*
As Easy As	Amy's First Primer	Blackjack	Toy Box II
FormGen II	Animated Alphabet	Chinese Checkers	Viruscan
Draft Choice	Animated Maths	Crystal Cave	
Label Magic	PC-Fastype	Forbidden Planet	This easy to
Print Partner	Sky Globe	Goodbye Galaxy	use software
Resume Prof.	World Rescue	House of Horror	is available
		Hugo II - Whodunnit	on 3.5 and 5.25" disks.
		Jungle of Doom	PLEASE
		Mahjong VGA	SPECIFY
		Paganitzy	DISK SIZE
		Shrapnel City	WHEN
		World Empire	ORDERING!
		Wolfenstein 3D	

All the same price ONLY $9.95 ea!

8.30am to 5.00pm Mon to Fri. 8.00am to 12 noon Saturday.
Mail Orders add $5.00 min to cover postal charges.
Next day delivery in Sydney add $8.00.
All prices include Sales tax unless stated otherwise.
Tax exemption certificates accepted if the line value exceeds $10.00.
BANKCARD, MASTERCARD, VISA, CHEQUES or CASH cheerfully accepted. READER INFO NO. 26

GEOFF WOOD ELECTRONICS

Geoff Wood Electronics Pty Ltd and Semtech

(inc in N S W)

229 Burns Bay Road, Lane Cove West
N S W 2066 (Corner Beatrice Street)

Telephone : (02) 428 4111 Fax : (02) 428 5198

EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
Altronics	WA	•	•	•	•	•	•	•
Companion Computers	VIC		•					
Dick Smith Electronics	ALL	•	•	•	•	•	•	•
Emona Instruments	NSW						•	
Geoff Wood Electronics	NSW	•	•	•	•	•	•	
Jaycar Electronics	Eastern	•	•	•	•	•	•	•
Kalex	VIC			•				
Macservice	VIC						•	
RCS Radio	NSW			•				
Rod Irving Electronics	VIC	•	•	•	•	•	•	•
Scientific Devices	VIC						•	
TECS	VIC	•	•	•	•	•	•	•
Wagner Electronics	NSW		•		•	•	•	

KEY TO CODING:

A Kits and modules
B Tools
C PC boards and supplies
D Components
E IC chips and semiconductors
F Test and measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

Electronics Australia Reader Services

SUBSCRIPTIONS: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Co, PO Box 199, Alexandria 2015; phone (02) 353 9944.

BACK ISSUES: Available only until stocks are exhausted. Price A$7.50 which includes postage within Australia only. **OVERSEAS READERS SHOULD ADD A FURTHER A$2.50 FOR EVERY BACK ISSUE REQUIRED.**

PHOTOSTAT COPIES: When back issues are exhausted, photocopies of articles can be supplied. Price $7.50 per project or $15 where a project spreads over several issues.

PCB PATTERNS: High contrast, actual size transparencies for PCBs and front panels are available. Price is $5 for boards up to 100sq.cm, $10 for larger boards. Please specify negatives or positives.

PROJECT QUERIES: Advice on projects is limited to postal correspondence only and to projects less than five years old. Price $7.50. Please note that we cannot undertake special research or advise on project modifications.

Members of our technical staff are not available to discuss technical problems by telephone.

OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.

PAYMENT: Must be negotiable in Australia and payable to 'Electronics Australia'. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form).

ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria, NSW 2015; phone (02) 353 0620.

PLEASE NOTE THAT WE ARE UNABLE TO SUPPLY BACK ISSUES, PHOTOCOPIES OR PCB ARTWORK OVER THE COUNTER.

METHOD OF PAYMENT: (Please circle correct method).

Credit Card: Mastercard
Cheque: American Express
Money Order: Visa
Bankcard

Expiry Date: .....

Name:.....

Address:.....

.....Postcode:.....

Back Issues:.....

.....

.....

Photostat Copies:.....

.....

.....

No.of issues required:.....$7.50=.....

No.of copies required:.....$5.00=.....

No.of copies required:...$15.00=.....

Total Payment Enclosed $ ========

Signature:.....
(Unsigned orders cannot be accepted).

ADVERTISING INDEX

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

UNINTERRUPTABLE POWER SUPPLY (UPS)

Contains a 24V DC to 240V AC, 50Hz Sine Wave Inverter! Use it as a portable mains power supply on boats, in caravans, for solar powered systems, or simply for its original function: As an uninterruptable power supply for a computer.

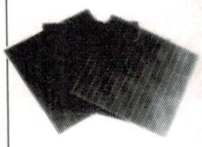
We have a limited stock of 300 watt UPSs. They are complete except for a few mounting screws. Some of these may be faulty or in need of a few modifications. A copy of the service manual (18 pages) which includes the circuits, layouts, test procedures, and modifications will be provided with each unit.

All the necessary UPS electronics are contained on one PCB which is easy to service. Employs modern high frequency switching techniques in the inverter section. A smal separate PCB contains a mains filter. The four mains output sockets on the rear panel are all individually switched by illuminated switches. The UPSs used two 12V 6.5Hr batteries connected in series; not provided. Inexpensive and common locally available devices are used throughout. LM324s, 40106s, TL494, 7815, LM317, IRF540s, IRF830s, etc.

The giveaway price for the complete unit? **$60**

We may also have available some later model UPSs for around $100. Some 600 watt new units may also be available.

SOLAR CHARGER

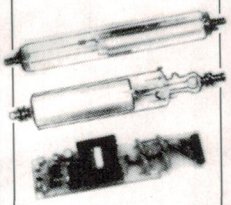


Use it to charge and or maintain batteries on boats, for lighting, solar powered electric fences, etc. Make your own 12V-4W solar panel. We provide four 6V-1W solar panels with terminating clips, and a PCB and components kit for a 12V battery charging regulator and a three LED charging indicator. See March 93 S.C. Incredible value!

$42

6.5Ahr. Panasonic gel battery $35. Electric fence PCB and all onboard components kit $40: See S.C. April 93.

12V OPERATED LASER TRIO



One used 3mW Siemens tube, one used laboratory quality 2mW tube, one universal 12V laser inverter kit, for a total of:

$99

DC MOTORS

We have good stocks of four different high quality Japanese DC motors. These should suit many industrial, hobby, robotics and other applications. Check out the SPECIAL prices, and compare!

M4 — 3-15V, I No load = 20mA at 12V, mains body 31mm diam, 22mm long **$3**

M5 — 3-15V, I No load = 60mA — 5700 RPM at 12V, main body 28mm diam, 40mm long **$2.50**

M9 — 12V, I No load = 0.52A — 15,800 RPM at 12V, main body 36mm diam, 67mm long **$8.50**

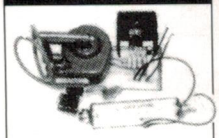
M14 — Made for slot cars, 4-8V, I No load = 0.84A at 6V, at max efficiency! = 5.7A — 7500 RPM, main body 30mm diam, 57mm long **$9.50**

Further to the above special prices, during April-May we are offering an introductory package which includes ONE OF EACH OF THE ABOVE MOTORS, and one of the STEPPER MOTORS ($12):

Five different motors for a total cost of

$26

EL-CHEAPO LASER



Probably the cheapest visible red helium neon laser and power supply ever offered, ANYWHERE! The kit includes a PCB, transformer, and all the components needed to make a 12V operated laser power supply, and a used laser tube with a power rating in the 0.5-2mW range. The PCB and all the onboard assembly is the same as the one used in our EHT Generator (it also now comes with a PCB), but a few extra necessary components and corresponding instructions are provided with the kit. Incredible value at:

$50

For the 12V inverter kit and a visible red laser tube. The EHT generator kit is available separately for $23.

VERY LARGE LCD DISPLAY MODULE

Brand new large 640 X 200 dot matrix LCD displays, made by Epson-Seiko, screen size is 120 X 265mm, has built in drivers. Four bit TTL interface, a total of 14 connections are required for signal and power (+5V, −12V). Capable of displaying characters, graphs, patterns, etc. 28 pages of data included. Unrepeatable price:

$69

Note that an LSI surface mount controller IC for this display is available elsewhere. More information supplied on request.

IR LASERS

REDUCED PRICES! This precision collimator assembly is supplied with a brand new laser diode to suit. Produces a well collimated laser beam at 780nM/5mW. Barely visible. We also supply a PCB and components kit plus instructions, for a suitable digital driver circuit that can be used to complete the laser transmitter. Suitable for communications, data links, perimeter protection, barcode reading, medical use, etc.

$69

We can also supply a similar kit which includes a laser diode, unmounted lens, and a driver kit:

$39

Note that a suitable receiver to use with these transmitters, for long range perimeter protection, was published in E.A. April 81.

LARGE LENSES

Two pairs of these new precision ground AR coated lenses were originally used to make up one large symetrical lens, for use in IBM equipment. Made in Japan by Tominon. The larger lens has a diameter of 80mm and weighs 0.5kg. Experimenters delight at only:

$15 for the pair

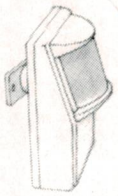
LASER GUN SIGHT

A 5mW gunsight at an unbeatable price.

$279

Includes one "Free" rifle or pistol mount.

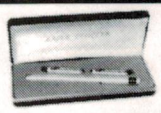
PULSE COUNT PASSIVE INFRARED MOVEMENT DETECTOR



This high quality Australian made PIR features true pulse count circuitry. Digital circuitry that actually counts the number of pulses, not just an R-C time constant. The pulse count is even registered by a separate green LED and the number of pulses desired is set by a DIP switch: 1-6 pulses. Both the green LED (pulse) and the red LED (detect) can be switched off after testing. Switched by the dip switch. 12M range with the standard 90 deg. wide angle lens supplied or 20M range with an optional narrow angle corridor lens.

SPECIAL INTRODUCTORY PRICE: **$46**

LASER POINTER



High quality pen sized 5mW laser diode pointer for teachers, doctors, etc. ON SPECIAL FOR

$169

BIG LASER TUBES

New 40mW helium neon (visible red) laser tubes: One metre long! Need approximately 3KV at 20 mA to operate. For discos, displays, holography, etc. Incredible introductory price:

$990

PROJECTION LENS

Main body has a diameter of 117mm and is 107mm long. The whole assembly can be easily unscrewed to obtain three very large lenses: two plastic and one glass. The basis of the cheapest large magnifier or projection system? Experimenters delight at

ONLY **$30**

VISIBLE LASER DIODE BARGAIN

LOOK

THE CHEAPEST 5mW VISIBLE LASER DIODE EVER OFFERED

Brand new 5mW-670nM laser diode, plus a collimating lens, plus a driver kit, plus instructions.

$85

ELECTRONIC KEY KIT

Use them to activate door strikers for entering buildings, car alarms, cental locking, the most secure key ever (see E.A. July 92). ON SPECIAL @

$49.90

For two keys, and one decoder kit.

STEPPING MOTORS

Brand new units. Diameter 58mm, height 25mm, 5V operation, simple to drive (two phase — 6 wires), 7.5 degree steps, coil resistance 6.6 ohm.

$12

6V GEL BATTERIES

Brand new Japanese 6V-500 mA Hr. Gel batteries. Fresh stock, charged, and very compact. 57 X 50 X 13mm. Limited quantity at

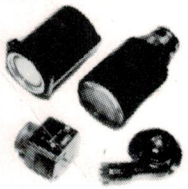
$7 per pack
or **5 packs for $30**

DIVERGING LENS

A high quality laser beam diverging (beam expander) glass lens, mounted on an aluminium plate, with mounting screws provided. Dimensions: 25 X 25 X 6mm. Use it to expand the laser beam for Holography, Special Effects, or one of the two lenses required to fine focus a laser beam, for Surveying and Bar Code Reading.

$9.90

NIGHT VISION COMPONENTS



ON SPECIAL is a set of components that can be used to make a complete passive first generation night viewer using the XX1080 tube. Produces useful pictures in sub moonlight illumination and can be IR assisted. We provide a matching lens and eyepiece, XX1080 tube with its original connectors, and a small kit power supply.

$270

At the time of publication we should also have available similar sets of matching components based on active first generation tubes. Prices for the sets should range between:

$150-200

We should also have available some fibre optically coupled, second generation image intensifier tubes, with built in power supplies. Operate off a 3V battery. To make a complete scope which will respond in as little a starlight illumination, all that is needed is a 3V battery, a switch, a low light lens, and an eyepiece. The tubes are used (ex-military) and may have some minor blemishes, but all produce full gain. Priced at a small fraction of their real value:

$500-700

MAINS POWER SUPPLIES

Brand new regulated power supplies. 240V mains in — 13.6V or 14.2V at 1.8A continuous output. Less than 2mV Pk-Pk ripple at 1.7A. Has additional output terminals for battery charging. 450 mA maximum. Approved Australian made units that employ a low profile Ferguson PL18 — 40VA transformer, and a regulator circuit (easily modified), in a very compact, all metal housing: 170 X 95 X 50mm. Mains lead — plug attached: 1.8M long. Information/specifications provided. Limited quantities at:

$30 ea.

OATLEY ELECTRONICS

PO Box 89, Oatley, NSW 2223

Telephone: (02) 579 4985 Fax: (02) 570 7910

MELBOURNE AGENT: TRUSCOTTS (03) 723 3860

MAJOR CARDS ACCEPTED WITH PHONE AND FAX ORDERS

P & P FOR MOST MIXED ORDERS:
AUSTRALIA: $6; N.Z. (Air Mail): $10

READER INFO NO. 29

- ACCURATE
- COMPACT
- RUGGED
- RELIABLE
- AFFORDABLE

The reasons for choosing Tektronix stack up as well as our bench test equipment

Tektronix TM 250/TM 2500 Series bench test equipment is designed to cater for a wide range of applications ranging from basic to advanced.

It is equally suitable for teaching situations, industrial applications and for the advanced hobbyist.

The rugged, affordable Tektronix bench test range includes:

- Power supplies for lab and field work.
- Digital multimeters to measure AC and DC voltage and current plus resistance and decibels.
- Function generators for testing amplifiers, filters and digital circuits.
- Stackable multi-function counters, especially useful standards for calibrating other equipment.
- The versatile, multi-purpose basic bench set: ideal for schools, labs and production lines.

Call now for full details and specification information.

Free Call (008) 023342

Tektronix
Test and Measurement

READER INFO NO. 27